THE

ELECTRICAL REVIEW.

VOL. LII. JUNE 26, 1903. No. 1,335.

"ELECTRICAL REVIEW."

Vol. LII.] CONTENTS: June 26, 1903. [No. 1,335.

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THE

UNIVERSAL ELECTRICAL DIRECTORY

1903 Edition

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ELECTRICALLY-DRIVEN ROAD VEHICLES.

IT is not a little surprising, considering the importance of Lieutenant-Colonel Crompton's paper on "Applications of Electricity to Driving Carriages in Towns," read at the Engineering Conference last week, that so small an audience welcomed the author. Anything like a lively, useful, and informing discussion could, therefore, scarcely be expected, and, even as it was, some of those who had real facts and figures to offer, were handed over—or their contributions were handed over—to the tender mercies of the official reporter of the Conference, the Chairman, seemingly, being unable to clearly discriminate between points of real interest and vital importance, and the irresponsible chatter of those who indulged in nothing but empty platitudes.

Electric automobile cells, as everybody knows, are designed from a different standpoint to that which obtains in stationary battery practice, and they are roughly divided into two classes :—One, those with a moderate output per pound of complete cell and a reasonable period of life; the other, those whose life is sacrificed to a large output per pound, the idea being apparently to run the cheapest and lightest possible battery for a short time only. When it begins to give trouble, or shows considerable diminution in output, it is considered the most economical plan to scrap the plates and put in new sections, not even troubling to utilise the old negatives with fresh positives. It is, however, the opinion of many capable of judging, that the better plan is to employ a heavier make of cell for traction purposes, with a longer life, rather than to fit the carriage with cells in which the weight is reduced regardless of every other consideration.

Touching the large outputs for weight now claimed for automobile cells, it may be interesting to hark back to a Faure-Sellon-Volckmar cell described in 1888 by M. Emile Reynier. Its output was as high as 7·5 ampere-hours per lb. at an eight-hour rate. The electrodes were of the grid type, about $\frac{1}{16}$ in. thick, and consisted of equal weights of support and active material, the specific output of the latter being 45 ampere-hours per lb. The cell had an output of 155 ampere-hours, and weighed 21½ lbs. total. Nothing was said as to its life, so that probably it was but a laboratory experimental cell, unfitted for daily use; we are not sure, indeed, whether it was even intended for traction purposes.

Mr. W. Worby Beaumont, in his compendious work on "Motor Vehicles and Motors," says :—"Given the electricity supply, nothing would be better than the electric motor for the propulsion of vehicles" . . . . "the electricity supply, however, is still almost as great a problem as ever, because the weight of secondary battery which must be carried for even a 25-mile run in any but flat country is prohibitive." . . . . "Even if a battery of theoretically least weight could be used, that weight would still hopelessly

handicap the electrical vehicle for long-journey work over average country." "Discovery must be made of means of employing materials other than lead and its oxides or salts." This was written in 1900.

Mr. E. J. Wade, however, the author of the most recent and most important work on "Secondary Batteries" which has yet been published, evidently thinks that we have by no means reached finality in the use of lead, and the Elieson battery which one of the speakers introduced to the meeting, and for which we hold no brief, apparently shows that Mr. Wade was correct in his assumption.

But the data connected with the practical running of a carriage fitted with these cells were tabooed by the Chairman, and the remarkable qualities of the cell, particularly that of receiving its full charge in three-quarters of an hour, seemed to be lost upon, or misunderstood by, those present. This appears all the more curious when one hears of the preparation for a 50 miles' journey by one of the gentlemen who took part in the discussion, who charges his cells for *10 hours* to get the best efficiency. Luckily, Mr. Llewellyn Preece, who had for some time subjected the Elieson battery to very severe tests, although the last speaker, was able, at the psychological moment, to practically fill in what, by the direction of the Chairman, had previously been left incomplete.

Too much valuable time was lost through those who had axes to grind (and, with two or three exceptions, the speakers were pecuniarily interested in what they advanced) combatting one another's views on front and rear driving, the merits and disadvantages of solid or pneumatic tires, chain *v.* tooth gearing, and the cost of electricity at central stations, forgetful, apparently, that all these are of no avail without the battery to supply the electrical energy, the vital part of the whole business. Even the author's trump card, viz., that all that is necessary to further reduce the cost of accumulator traction is standardisation—that is to say, that the supply of charged accumulators to replace empty ones should be undertaken very much as the supply of fodder and forage for horses—loses much of its value in the face of the fact that you can now have your battery charged while you are partaking of breakfast or luncheon.

Standardisation in the way of a standard voltage, wherever one may be stopping, is certainly very desirable; but that standard must be low enough to keep down the number of cells in a vehicle. Carriage makers cannot build to use the 200 volts or more of many of our central station supplies; central station managers must arrange to meet the voltage requirements of the accumulator car.

It should be clearly understood in connection with electric automobiles that the actual efficiency of the battery represented by the ratio—Output : Input, is of altogether minor importance. The fundamental requisites are—large capacity; ability to stand high charge and discharge rates; durability *or* cheapness (*i.e.*, low cost of maintenance); lightness and reliability. Of the qualities named above, that of rapidity of charge is of prime importance, and although this of necessity entails a reduced watt-hour efficiency, the loss takes the form of *increased input, not decreased output*—a distinction of great significance in this connection. The advantage of being able to fully charge the battery within the hour is infinitely more weighty than the disadvantage of paying 40 per cent. more for the charge.

Referring to the actual trials of the Elieson cell in an automobile, it is interesting to note that, taking the weight of the car, with passengers, as ½ ton, and No. 2 run to Reading as 50 miles, the ton-miles were $50 \times \frac{1}{2} = 25$. Also the charge was 8 units, and at 60 per cent. watt-hour efficiency, the discharge would be nearly 5 units. Thus the units per ton-mile, an important datum, were = ·2. This is about double the value found with tramcars, showing that traction on roads offers practically double the resistance of traction on rails. Moreover, the cost of 8 units at, say, 2d. per unit, would be 16d., so that the cost of energy per mile of route traversed by the two passengers would amount to no more than ·32d. This more than bears out the author's estimate, and our own statement that, even with electric automobiles, the cost of energy is immaterial. It will be noticed that this car was very light and speedy, just the kind of thing, in fact, which seems likely to become popular for everyday use.

Lieut.-Col. Crompton has evidently great faith in the future of the electric automobile, and we are equally optimistic. The London Electric Cab Co. showed some years ago that electrically-propelled cabs were practical though not then economical; to-day we have passed the first stage, and it only remains to demonstrate that the use of secondary batteries may be made commercially successful in daily practice under ordinary conditions of road traffic, to swell the number of vehicles now running to the thousands which the author foresees will come in two years' time.

To do this is not so easy. Nearly all the money invested in exploiting these ventures is confined to the carriage builders; the secondary battery inventor, the man who supplies, so to speak, the very soul of the thing, does not so readily find the necessary financial support.

Still, with the batteries already in the market approved by Lieut.-Col. Crompton, and better ones in view (assuming the Elieson data to be correct), the gallant officer's faith in electric traction on ordinary roads should now be within measurable distance of becoming realised.

MOTOR-CARS FOR RAILWAYS.

THE rapid development of electric tramways in this country renders it impossible for steam railways to ignore the damaging effect of their competition on short suburban and branch lines. The majority of our railway companies, for many reasons, do not wish to make such drastic changes as would be necessitated by the electrification of their lines, and have been casting about for some system, other than electric, which will decrease working expenses, and enable them to offer the public a better service than heretofore. Under such circumstances, it is only natural that the rapid progress and recent success of the self-contained motor-car should have attracted their attention, and led some of them to investigate the possibilities of this system of traction as applied to railways. Results, however, have not quite come up to expectations, and the reason is not far to seek.

It is true that the recent motor-car trials on common roads, both on the Continent and elsewhere, have demonstrated that speeds equal to, and sometimes in excess of the maximum average speeds attained on main line steam railways, can easily be attained, but this fact by itself is of little or no commercial importance. The attainment of high speeds is almost entirely a question of the proportion of power to weight carried, and if this ratio is sufficiently large, there is no difficulty in running at between 70 and 80

miles an hour. The modern racing car, weighing about 1 ton or less, requires approximately 100 H.P. to give the high speeds required, but to equip railway carriages with motors in the same proportion to their weight as this, is quite out of the question.

If railway companies were only looking for a motor-car which would run at the comparatively low average speed of from 15 to 20 miles an hour, the solution of the problem would be easy, and, in fact, was discovered 10 years ago, amongst others, by the Belgian State Railways, when they introduced a service of light steam motor-cars to handle suburban traffic round some of their big towns. But such a service is of little use as a protection against electric tramway competition.

The ordinary petrol motor-car is in many ways unsuitable for use on suburban railway lines having a heavy traffic. The large amount of gearing required causes considerable loss of power in transmission, and to obtain the best results requires an exercise of care and delicacy of adjustment, which in itself should be sufficient to cause railway companies to hesitate before putting such intricate mechanism into service. Another strong argument against their use is that petrol engines, being of the reciprocating type, cannot give high rates of acceleration, unless the transmission to the wheels is done electrically and storage batteries are added. That reciprocating engines are of little use to give large acceleration has recently been clearly demonstrated by the results obtained with the huge "Decapods" designed by Mr. Holden for the Great Eastern Railway. The acceleration obtained with these locomotives, whilst being very creditable for steam roads, was under 1·5 ft. per sec. per sec., which is not much to boast of, compared with the rate of 4 ft. per sec. per sec., obtained on the Liverpool Overhead Railway.

The North-Eastern Railway has been experimenting with a car fitted with a Diesel petroleum motor in combination with an electrical equipment supplied by the British Westinghouse Co., but from reports to hand the results do not appear to have been very satisfactory. The London and South-Western Railway has also recently put into service a steam motor-car running between Fratton and Southsea, the object being to give a more frequent service without the expense of running comparatively heavy trains which there are not enough passengers to fill. In spite, however, of the short run, and the light traffic, this car requires a considerable rest to pick up steam after each journey.

With steam-driven motor-cars, unless some such system as the Serpollet is employed, the same waste will occur as with ordinary steam locomotives, as the fuel consumed when standing still is not much less than when running.

Some railway men are still awaiting the advent of a perfect electrical accumulator, and doubtless the discovery or invention of such a thing would solve many problems. There are strong indications that good progress is being made towards this end, and the important experiments in accumulator traction on railways which are being carried on in Italy and Germany deserve serious attention.

From a careful study of the whole question, it does not appear to us that self-contained motor-cars, whether steam, petrol, electrical, or worked on some combined system, are likely to prove serious competitors to electric haulage on urban, suburban or interurban lines carrying a heavy traffic. Their best sphere of action would seem to lie in short country branch lines where high average speeds are not required, as, for instance, the South-Western line between Fratton and Southsea, which we have already mentioned. We are of opinion that such lines would greatly benefit by the adoption of motor-cars, and if required arrangements could be made for them to stop at crossings, and practically anywhere else required, to take up and set down passengers, and the cars could run at any frequency which would best suit actual demands.

LEGAL.

Patent Exploitation, Ltd., v. The American Electrical Novelty and Manufacturing Co., Ltd.

(*Continued from page* 1034.)

Mr. Henry Charles Braun, examined by Mr. Walter, said he was a consulting engineer practising at King's Cross, and carried out a large amount of experimental work for inventors. Before 1889 he had been interested in questions of batteries for many years. In 1885 he went to France to make inquiries from people there in connection with dry batteries. There were a number of them made about that time in Paris, and being sold by Woodhouse & Rawson; Graefe was one of them, and there were others whose names he did not recollect at the moment. He was partner with Mr. Ford-Lloyd from 1886 to 1889, and since he had ceased to be associated with him he had no connection with batteries or with the Universal Battery Co. Whilst he was working with Mr. Ford-Lloyd, he made hundreds of dry batteries of different kinds for experimental purposes. He had made a battery with a zinc pot, and had sold batteries to an automatic company. The last batteries before he left in 1889 were made with an outer cell. In some instances they put the outer zinc case into an earthenware case or pot to prevent short-circuiting when they were close together. The containing vessel was zinc, which was one of the electrodes, the other electrode being, as a rule, some form of carbon. The excitant was sal-ammoniac in both cases. It was a semi-fluid battery. The substance they used in the outer layer was flour, or arrowroot or sawdust, to render the plaster more porous. They also added sal-ammoniac, glycerine and water. They used to stick in brown paper or blotting paper, or something of that sort, to keep the whole thing together, because, in damp weather, it fell down more or less. Between the blotting paper and the carbon rod they put a mixture, probably peroxide of manganese and broken-up carbon. It was put in dry and was mixed up with powdered sal-ammoniac and glycerine. After the mixture was put round the carbon it was pressed in, there being a little pitch dropped into the bottom of the pot so as to make the carbon rod stand up while it was being put in. The blotting paper was not used in all cases. The batteries were made afterwards without blotting paper.

Cross-examined by Mr. Astbury, witness said the date of his last dealing of any sort with Mr. Ford-Lloyd was some time after 1889. He (witness) simply drew a percentage of royalty on their joint battery after that. He was advised not to patent it because it was partly old and more or less like several of the others. He thought there was not sufficient novelty in it to patent it.

Mr. James Swinburne, examined by Mr. Moulton, said that in 1890 it was no novelty to make a dry battery. The only object of making a dry battery was to make it portable, unspillable and lasting without being replenished. He had read the plaintiffs' specification, and, speaking generally from the electric point of view, there was no novelty whatever shown in the description there given. In the last case he thought there was. He thought the fineness was new, but he had found out since that that was not so.

First, as to the battery that is there described in detail—is there in that anything which to you, as an electrician, was novel at that date?—No.

The Witness was then taken *in extenso* through the plaintiffs specification, and said that, taking the knowledge at the time, it was known that you might use a very large number of different salts as excitants for a battery like that, including acids. An acid excitant would do better in every way to give a good current, excepting that acid left in contact with zinc was apt to work into the zinc and give off hydrogen. To avoid that, they amalgamated the zinc. There was no more objection to an acid excitant in a dry battery than in a wet, if you wanted it for portability. The acid would be better as far as portability went. Acid solutions were the better conductors. So far as the question of paste *versus* fluid in two layers was concerned, there was no objection to acid when you had a paste. All the storage battery accumulators were made with fairly strong sulphuric acid—1 in 10, up to 1 in 5. A man called Schoop brought out a particular form of dry battery, and there had been several others. It was known that you could have either a fluid outer layer or a semi-solid outer layer. Paste outer layers were matter of common knowledge. A common method of turning the outer layer into a pasty condition was where a cell was made with mercury sulphate. Skrivanov was another, who used mercuric salt, with lead peroxide inside. The most common way of turning a fluid battery into a paste battery, was by sawdust and blotting paper, and things of that sort. It did not make a paste exactly; it made an absorbent. Asbestos was another. Then there was plaster of paris.

Do you see, reading plaintiff's specification as an electrician, that the intention of the specification is to exclude from his claim any form of paste?—No, the only thing apparently is the physical condition, the two layers of exciting composition in a semi-solid or plastic state, one with a depolariser, one without. That is as far as I can make out the point of it.

Examined as to the depolarising agents as the central layer, Witness said that pulverised peroxide of manganese and pulverised carbon were old materials, and were largely used by Leclanché. It was not novel to powder the two substances. In the last case he had said that the fineness of these things for Leclanché batteries was new to him. Since then he had looked up the matter and found that Leclanché apparently started with fine powders, and found, for some reason, that they did not conduct, and rejected them, using larger powders. Then a man named Bates investigated the

matter thoroughly, tried various kinds, and he found that the carbon ought to be coarsely powdered and the manganese ought to be very finely powdered.

Mr. Astbury: Are you talking about this publication, Wiedemann?—Yes. He experimented, and that was the result, his idea being that the carbon should not be fine, because if the carbon is in large particles it can conduct and make a sort of tree, and he gives as his result that that works best.

Mr. Moulton: Fine pulverisation of the manganese, comparatively coarse pulverisation of the carbon?—Yes, he is dealing with a porous pot cell. What has altered the aspect of this, to my mind, is, now I find they ram the cell. If you do not ram, the fine particles will not conduct. If you ram it tight and get the particles into contact, it will conduct.

Take Bates, apart from the conclusions he comes to as to what is best, does he examine into the question of finely powdered carbon and mangan, finely powdered manganese and coarsely powdered carbon and *vice versâ*?—Yes. He examines them for use in a Leclanché as a depolariser.

Mr. Justice Buckley: What is the date of this?—That would be in the early eighties.

Further questioned by Mr. Moulton, Witness said Bates's paper was in 1872. Bates was a very well known scientific man.

With regard to that book of Wiedemann, is that a standard book?—Yes, one of the books that Lamb says ought to be on every man's shelves and stay there—no one reads it.

Mr. Astbury: Mr. Swinburne had not heard of it apparently in the last case?—I had it on my shelves but had not read it.

Mr. Moulton: It is a classical book on electricity, is it not?—Yes. It is out of date a little now, but it is very full.

Had you any reason to doubt that the conclusion he came to, apart from the things he examines, was that somewhat coarsely powdered carbon and finely powdered manganese would be the best?—I think that is right. I am not sure whether it would be altered by ramming—whether in that case you could not use both fine; but his work is quite right, no doubt.

Answering other questions, Witness said the defendant's material in the inner cell was a damp powder, but it was not a semi-plastic or plastic mass. It was rammed hard.

Supposing you have two outer layers equally porous, and one hard and the other soft, does that make any difference electrically?—None whatever, as long as the hard layer is always in contact with the zinc. The only danger of a very hard layer is it might have a different shape to the zinc, and not make contact, so that air would come down between.

Further examined, witness said that Brandon, so to speak, was a Leclanché with sawdust in it.

Was it a superstition among electricians to put in porous pots when they were not wanted?—No, it has generally been the other way. Possibly unnecessary trouble has been taken to remove porous pots from all sorts of electric cells.

Was there any invention, in your opinion, in leaving out the porous pot, if your outside layer was strong enough to stand?—No, the outside layer is the porous pot, really. It fulfils the same intention.

Was blotting paper perfectly well known as a means of holding an excitant?—Yes; I used it myself in 1882. It was just an ordinary thing to me then.

Do defendants' cells differ electrically from what Brandon would be if you put blotting paper in instead of sawdust?—No; except Brandon, as described, has an earthenware porous pot. If you use a jar—the old Leclanché jar—you must start with a porous pot to hold the stuff put inside. If you are going to start with zinc or start with something from the outside, and work inwards, then you do not need the porous pot.

Supposing the defendants put the porous pot in and it was equally pervious with the blotting paper, would that make any difference at all?—None.

Does Thiebaut show a depolariser which is different to binoxide of manganese?—He has peroxide of lead.

Take Thiebaut made according to what he says with clay on the outside, carbon and peroxide on the inside in his way, and with, I think, sal-ammoniac as an excitant, would there be two layers there both plastic?—Yes.

The inner one being plastic in the same sense as the defendant's inner one is?—Yes.

Witness, replying to other questions, said there would be no difficulty for an electrician to make such a battery as was described by Thiebaut. Such a battery would work. In Germain there was a horizontal battery. He had carbon as a conductor and carbon and manganese oxide as the inner coating, and then cellulose, and then came the zinc. There was no difference between cellulose and blotting paper for the purpose for which it was used. Germain's was a practical battery. Castle-Smith's prescription would succeed if used as described by him. The battery would be unspillable. Agar-Agar made a stiff jelly. Hellesen was a perfectly effective battery, because the resistance of a jelly was very low. Assuming that the central part was equally rammed, there was no reason why that should be inferior to the receipt given in the plaintiffs' specification. The specification of the earlier Hellesen, No. 4,369, of 1885, called Jensen, described the manufacture of the internal layer, which, when manufactured, would be the same as the internal layer of the defendants or the plaintiffs, as made. In Gassner's United States patent the external layer did not differ substantially from the one described in the plaintiffs' patent. A cell of that kind electrically was the same as either the plaintiffs' or the defendants'. In Bender there was also electrically no difference between it and the cell described in the plaintiffs' specification. It was a practical cell, and there was nothing in Bender which would prevent anyone choosing at will the fineness of the manganese or carbon or adopting peroxide of lead instead of peroxide of manganese. Skrivanov was a battery which would work, and could be made in the cylindrical form. The originality in Skrivanov was the taking of something which was not binoxide of manganese; in fact, there the layer next to the carbon was pasty. It was a perfectly old way of making an external layer. It was not true that the prescription given by the plaintiffs' was better than the defendants' battery. On the contrary, the "ever ready" battery, as it was called, was about the best he had come across.

His Lordship: Do you say that the plaintiffs' prescription in abandoning blotting paper which he says was used before, and going back to the outer layer, is a step backwards or forwards?—I should have said that the plaintiffs' was a step backwards, my Lord.

Witness was next examined as to Walker, and said that apart from the question of there being a carbon rod inside the paste, that would lead to a centre of the same character as that used by the defendants or used by the plaintiffs as made. He saw no difference in the exciting layer in Webb and Jensen, described on page 3, down to line 27, and that described in the plaintiffs' specification.—The hearing was adjourned.

On Wednesday, June 10th, Mr. James Swinburne, cross-examined by Mr. Astbury, agreed that there were many commercial *desiderata* which had no relevance at all to chemical or electrical action in the case of these batteries. It was very important to have a battery which could be kept in stock for months or years by an ironmonger and then used, and it was important commercially that the thing should be capable of being knocked about and stand a certain amount of rough usage. Cheapness was very important, and it was also important that it should have a good life. In the last case his view as an electrician was that this fine pulverisation was not only a novelty but one of the chief contributory causes to the success of the battery.

The general impression that you had as an electrician in the last case was that owing to the experiments, the world had come to the conclusion that you must avoid the dust and powder in the manganese portion of the battery?—Yes, that was my impression.

That impression is only altered in this case to the extent of the documents that have been put in that were not referred to in the last case. You are not giving evidence of change of view other than what you have found in the documents which have been referred to?—Yes, and not only the documents but the fact of ramming.

I am simply on the pulverisation as a novelty first?—As a novelty, that is so.

I see one of your answers in the last case was that it was the idea of electricians, at all events up to 1890, to avoid powdering with reference to peroxide of manganese; that was your view?—Yes.

This book of Wiedemann is one of the documents which has led you to give different answers?—Yes.

There is nothing in these experiments of Wiedemann to show that he is putting his fine powder in a porous pot, or that he is testing the strength of a battery so constructed?—You mean to suggest that he may be really working with it on a plate at the bottom of the cell.

He does not say how he is working?—I do not remember. This, you must remember, is an abstract from the paper. I do not remember what he says in the original. I do not remember anything about the porous pot. I read it as if it was a porous pot.

Cross-examination continued: After the date of Brandon's specification in 1866, the battery world came to the conclusion that powdered dust ought to be avoided in a Leclanché battery. In practice he had never heard of a battery being made according to this specification of 1866.

Is the Brandon anything more than a suggestion to put powdered materials into the porous pot of a Leclanché battery, and then build the thing up with sawdust?—That is what it is, practically.

Do you think that a battery made according to this—an ordinary Leclanché stuffed up with sawdust—would have the same results commercially as the plaintiffs' battery?—Not as the plaintiffs' battery, but I think it would be as good as a battery made according to the particular directions in the plaintiffs' specification.

Do you mean to tell me that a battery made like this would ring for 27 days and nights without stopping?—I think it is quite probable.

How long will an ordinary wet Leclanché ring for?—I do not know.

Five minutes?—I really do not know.

Cross-examination continued: He saw no novelty in the plaintiffs' outer layer, and nothing new in the inner layer in the plaintiffs' battery. What he meant was that there was nothing new in using the powdered carbon and powdered manganese powdered fine, all the rest being old. Now the fineness was all removed the rest was all old. The only reason why the fineness was removed was because of Brandon and Wiedemann. The outer layer in the Hitchcock battery was a layer which permitted the free permeation of water through it. It was also a layer which sufficiently prevented the powdered manganese from getting to the zinc, and those actions were essential to its success as a battery. It was also important that the material next to the zinc should for the purposes of success maintain complete contact throughout with the zinc. It was, further, important if you had no bag or diaphragm, that the outer layer should not develop cracks in working, through which the manganese might penetrate. It was a fact that the outer layer, made according to Hitchcock's prescription, answered those points, and that the outer layer in the defendants' cell also answered those points?—There were four documents of Thiebaut.

All lodged in the Patent Office at the same time?—It may be so.

There is a good deal of nonsense in those four documents?—I think there is some.

Suppose that anybody went to those four documents uninstructed by any other document, in order to make a battery that would act successfully, he would have to know what to discard and what to choose?—Yes.

Look at the patent of April 26th, of the year 1881. That document is an absurdity?—Part of it is absurd.

The second document is little better?—It is better.

It is only a question of degree?—The thing which makes it not workable is removed. The application of the depolariser to the zinc is removed.

But the other objects remain?—It is not such a good cell. It is not an unworkable cell. The cell is not unworkable because it is hard, but it is very much better to have it soft.

In the first patent he kept in the dust. In the second, of April 3rd, 1882, he gets rid of the dust and uses grains. And in the third document he gets rid of the grains and uses agglomerate blocks?—Yes.

This third document is the only one in which clay is mentioned, and you do not make your battery according to it at all?—No. I have made the battery, if you like to put it so, like the ones in question.

You have made it with all the knowledge of the plaintiffs?—Well, with the knowledge of to-day, or the knowledge of 1890.

And you have not made it according to the way that anybody reading this second addition would fairly arrive at?—I would not say that at all.

Does he say that the plaster can be replaced by lime?—Yes.

What would be the result of putting in lime instead of plaster of paris?—Lime with the sal-ammoniac would probably give off ammonia.

Would it be perfectly ridiculous in a battery to put in lime?—It is not a thing that a chemist would do. It would be absolutely wrong.

Then he says "or by cement." Supposing you fill your battery with agglomerate blocks and Portland cement outside, how long would it work as a battery?—I do not know.

You do not suggest that it would be a good battery?—I do not say it would be a good battery compared with the E.C.C., but it would work and give a current.

It might give a current, but it would not be comparable with a battery made according to Hitchcock's prescription?—No, I have told you it is not comparable.

Is it true to say of the exhibit you have handed in that you have picked out clay from among three things, two of which would be very bad indeed, that you have departed from Thiebaut's direction to use agglomerate blocks and have gone to his discarded idea of manganese and carbon, in which you have retained the dust?—The object of this is to show that clay will work as an outer layer, and it shows that.

Am I right in saying that that exhibit is not in any way made in accordance with the directions contained in the second certificate of Thiebaut?—It is made is accordance with the directions to the extent of using clay.

And nothing else?—Any one without any regard to this case taking up Thiebaut and told to make a sample cell according to it would not of course produce this cell.

Take Germain. It is obvious, is it not, that a battery constructed according to this would, for commercial purposes, be a totally different article to a battery made according to Hitchcock?—This is only a laboratory type. It is not a commercial one. Except that it shows the use of cellulose and blotting paper which is analagous to our blotting paper, it is entirely irrelevant.

But the use of cellulose in this is simply a means of getting the excitant to the zinc and keeping the zinc off the carbon?—Quite.

Now Castle-Smith. I think you made a mistake about this tragacanth. You said that it did not make a mucilage, but made a jelly?—Yes.

Is one of the commonest uses of tragacanth for the purpose of making mucilage?—Not that I know of.

I want to know where you find a single word about filling the inner bag with manganese and carbon, or making your outer electrolyte of sal-ammoniac, or any justification for adopting that form?—The Hellesen was made that way.

I am talking about Castle-Smith's specification?—Then you will have to look at the other one, too.

Was Hellesen a man who fairly well knew what he was talking about?—I do not know. I only know him in connection with this battery. All these batteries are full of absurdities.

Assuming the man knew what he was saying, is not it obvious to anybody that he was trying to make a closed acid battery in which the spray would be avoided, and the gas absorbed?—Certainly anyone reading this document alone would think that was his object. He would be led to an acid cell undoubtedly.

And there is not a single suggestion in it from beginning to end for putting either manganese or carbon into the bag?—No.

Nor to powder either of them?—No.

Nor to put sal-ammoniac in the other mixture?—No.

Answering further questions, Witness said Jensen was another communication from Hellesen. It was four years earlier, and the specification dealt with nothing but a wet cell.

There is no suggestion in Jensen's specification from beginning to end, to make a cell in the way of the exhibit you have put in marked Hellesen-Jensen?—It is Jensen, with tragacanth added, and sawdust.

There is no suggestion in Jensen to make a dry cell of any sort or description?—There is a suggestion to make a dry cell, and it is made dry by adding sawdust.

Is the specification of 1887 one which substantially describes what was known as the Gassner cell?—I think so.

Mr. Cooper's book, at page 227, says: "The Gassner cell was the first cell which was commercially successful." Do you think that is probably accurate?—I should think so.

"But in recent years it has been surpassed by various other cells." Is that also accurate?—Yes.

Then he says: "In its construction it resembles the Lessing cell, in that the zinc plate is a cylindrical sheet which does not form the containing vessel. For that purpose a papier maché case is employed. The carbon, which is hollow, is of large diameter, so that a space of only about a quarter of an inch exists between the carbon and the zinc cylinder. This space is filled up with a white paste, there being no depolarising paste." It is no doubt on account of the absence of the depolariser that the useful life of a Gassner cell, when tested on a 10-ohms circuit, is so short, being considerably less than one day?—Yes.

(To be continued.)

[On Wednesday, June 24th, his Lordship gave judgment for the defendants with costs.]

National Electric Traction Co. v. Electric Tramways Construction and Maintenance Co.

Mr. Justice Swinfen Eady, in the Chancery Division on 19th inst., appointed a receiver in this debenture holder's action, for a month.

The National Telephone Co., Ltd., v. The Mayor and Citizens of Kingston-upon-Hull.

In the Chancery Division of the High Court of Justice on Monday Mr. Justice Buckley had before him this action which raised the question of whether under an Act of 1899, the powers of the National Telephone Co, Ltd., had been extended. Mr. Haldane, K.C., Mr. Astbury, K.C., Mr. Forbes and Mr. Lancaster Gay appeared for the plaintiffs; and Mr. Dankwerts, K.C., Mr. Buckmaster, K.C., and Mr. R. J. Parker for the defendants.

Mr. Haldane, in opening the case, said it raised an important point of law. The question was whether, in the nature of the Act of 1899, which was in a somewhat unusual form, the period during which the plaintiffs were entitled to maintain and work a telephone system under the powers they had from the Postmaster-General had been extended, the Legislature according to their view having created a statutory contract between the parties. The point was as to whether the result of certain acts done by the Corporation of Hull had had the effect of successfully preventing the operation of the statute. The position in 1899 was that a telephone system had been established under British patents. All those patents became consolidated in the National Telephone Co. In 1884 it was decided that telephones were telegraphs within the meaning of the Post Office Act, and therefore the Postmaster-General had a monopoly. The Postmaster-General granted licences to the plaintiffs, retaining possession of the trunk lines. Amongst the places that the National Telephone Co. had a licence to lay down a telephone system was Hull. In 1899 various Corporations went to Parliament and asked for an extension of their corporate powers in order to set up competing telephone systems. Parliament took the view that though the Corporations should have the powers, they must protect the National Telephone Co. If licences were granted by the Postmaster-General to the Corporations, they would take care that the Corporations did not get a monopoly, and the powers of the National Telephone Co. must be extended for the period during which the Corporation's licences would run. Accordingly, the Act of 1899 provided that where the Postmaster-General proposed to grant a licence to a local authority or any other person in the same area as an existing company upon the company agreeing to give favour or preference to any person, and not to charge more than a maximum rate, the licence of such company should be extended for the period for which the new licence was to be granted. The plaintiffs contended that, under that clause in the Act, they were entitled to a licence so long as the Corporation's licence existed, and that all contracts in existence at the time should be continued during the period of the licence. The Corporation had given notice to determine certain agreements with the plaintiff company. Hence the present action.

For the defence it was contended that the Legislature never intended to provide that whatever agreements were in existence at the date of the Act of Parliament should be continued during the period of a new licence to be granted.

At the close of the arguments, his Lordship intimated that, as the question raised was one of considerable importance, he would put his judgment in writing, and deliver it in a few days.

SOUTH AFRICAN NOTES.

(From our Special Correspondent at Johannesburg.)

June 1st, 1903.

Cape Town.—There is great opposition among the inhabitants of Sea Point and Green Point suburbs regarding the proposals of the C.T. Tramway Co., whose lines run through those places, to electrify the at present unworked Sea Point Railway. The company's tramway service is not considered satisfactory, and the feeling of the inhabitants is that it is undesirable that the possibility of competition should be extinguished, and that the Government should run the railway itself. The City Corporation and the Harbour Board agree with these views. The Sea Point Municipality are willing to guarantee the Government against loss out of

the rates, and at a meeting of the ratepayers this week a resolution to that effect was carried unanimously.

The street fire alarms of Cape Town have long been in an unreliable and dangerous state, and consequent upon the strong representations of Captain Hayne, the chief, a new system is to be installed. This will be on the "Gamewell" system, and the total cost will be £1,350.

Durban Telephones.—As mentioned some time ago, the Government were dissatisfied with the Durban Municipal Telephone Service, and decided to instal a system of their own. They therefore purchased the complete plant and equipment of the Natal Telephone Co., and this week completed a system connecting together half a dozen local departments, and entirely independent of the municipal service. The headquarters of the system are on the Main Wharf, the whole line of cargo sheds, water police, Customs, wharf-masters, &c., being connected. The system will greatly facilitate the business of the Harbour generally.

The "Sydenham Electric Tram and Lighting Bill" will be introduced into Parliament this week.

Potchefstroom.—A public meeting is called for 5th inst. with regard to the electric lighting of Potchefstroom. Some months ago several offers to light the town were received by the Health Board from Johannesburg firms, but the matter was indefinitely "shelved." The inhabitants, however, were not satisfied with this, and one prominent citizen, Mr. Hendriks, proprietor of the Queen's Hotel, has now on order a complete plant of his own. As others intend to follow suit, the Health Board have brought the matter up again, and the above meeting is called to consider the advisability of granting a concession for lighting the whole town and military cantonments.

PARLIAMENTARY.

Royal Commission on London Traffic.

Sir David Barbour presided on 19th inst. at the Westminster Palace Hotel over a further setting of the above Commission.

Mr. G. L. Gomme, clerk to the London County Council, continued his evidence, and described the powers possessed by the Council with regard to subways. The Council had no power to make a new subway, except with Parliamentary sanction. The Act of 1893 did not apply to pipes and wires laid under the Electric Lighting Acts nor by the Postmaster-General. In the Electric Lighting Confirmation Order, however, clauses were inserted authorising the Council to require electric wires to be laid in their subways. The Postmaster-General was not bound by law to lay pipes or wires in subways, but as a matter of practice, the Post Office did use the subways. The Council did not think that the existing arrangements were satisfactory, and they had proposed further powers. They had certain powers with regard to subways constructed for underground railways, and there were subways either open or in course of construction at the Bank and Charing Cross. They would like similar provisions to those they had in the Underground Railway Bills, inserted in all similar Bills in the future. The Highways Committee in 1901 reported to the Council on the question of the construction of tramway subways and subways in streets for the reception of pipes, wires, &c., and legislative proposals were introduced as the result of the Council's resolutions on the recommendations contained in the report. As a result the Council obtained powers to construct a subway for a shallow tramway under the new street from Holborn to the Strand, but the proposals to confer general powers on the Council with regard to subways were withdrawn.

The Chairman: The idea of the Council was to make subways for pipes and wires and tramways in any street without special application to Parliament?—Yes.

Sir G. T. Bartley: Without consulting the Borough Councils?—Yes.

Continuing, Witness advocated the laying down of an extensive scheme of subways for wires and pipes, and believed that the cost of such subways would, roughly speaking, be paid for by the companies who would use them for their wires and pipes. The Council still asked for power to make subways in any streets for electric tramways.

The Chairman: Do they consider the breaking up of the streets so great an evil as to make it desirable to have an extensive system of subways?—I think we may go beyond that and say it is almost necessary.

Do the Council wish a veto as regards the construction of underground tramways and railways?—They have that power as regards tramways, and would like it as regards railways.

By Sir Robt. Reid: The Council contemplated having subways for wires and pipes only in streets where they were not needed for tramways or foot traffic, and they would like general powers to construct such tramways where necessary. It would be quite possible to have all the electric and other wires and pipes placed in subways, and the rent which would have to be charged to recoup the Council for their construction would, be believed, not be greater than the cost of breaking up streets at present to the companies. Their engineer advised them that it was quite safe to place wires and pipes in the subways used for traffic. He knew of no objection which the Borough Councils had made to the construction of subways.

Replying to Sir J. Dickson Poynder, Witness said he did not think the Council would consent to lease subways to private enterprise for traffic purposes, although they had not passed any resolution on the subject.

Witness proceeded to deal with the question of street improvements, and stated that when streets were widened for tramways it was usual to charge one third of the cost to the local authority, one third to the tramway account, and one third was borne by the Council.

The Chairman: If the Borough Council does not agree, what happens?—If it is extremely urgent, as it is in some cases, the Council gives way. If not, the tramway is not made.

Would it be desirable to have some authority who would be able to settle the relative proportion of the cost to be borne?—I do not know that it would, because public opinion in London is already having its effect upon local authorities, and the Council feels that in due course the objection which has been held will not be held.

You think there is no prospect of much disagreement in the future?—I think the grievance is gradually being broken through by the course of events.

The Commission adjourned.

Croydon and District Electric Tramways.

Sir Edward Strachey's Select Committee of the House of Commons had this Bill, promoted by the British Electric Traction Co., before them on June 16th. Mr. Balfour Browne, K.C., Mr. Moon, K.C., Mr. Lloyd and Mr. Hutchinson represented the promoters.

In opening the case, Mr. Balfour Browne said that the Bill was to empower the company to construct tramways between Sutton and Croydon. The proposed line would commence with a junction with an authorised line from Mitcham to Sutton. From Sutton it would pass through Carshalton to Wallington, and from the last-named place it would proceed through Beddington to Waddon. At Waddon another authorised line would be connected up. With regard to the Mitcham and Sutton authorised line, counsel said that that line was to be transferred to the British Electric Traction Co. by the Croydon Council. The Mitcham line commenced at Tooting Junction, and doubtless, in future, the L.C.C. tramways at Tooting Graveney would be connected with it. The Bill was before the House last session, and as then proposed, the line would have passed through Carshalton Village, and objection was taken to this on the ground that the street was too narrow for a tramway. The present Bill proposed that the tramway should go by a different route. It was proposed to take the lines along a road belonging to the Carshalton Park Estate Co. This was opposed by that company, who asserted that the road was a private one, and intended merely as a means of access to their estate. They also objected to the overhead system of traction, which was the method proposed to be adopted. A large number of witnesses were called in support of the scheme.

Mr. J. W. Sawyer, chairman of the Council, considered that the trams would be of great benefit to the working classes who were employed in the district.

Mr. Richard Kingsbury, a solicitor, said he acted for a number of owners of property in the neighbourhood of the proposed tramways. He had always found that tramways increased the value of property.

On 17th inst., Mr. Pollock asked that an adjournment be granted until after lunch. He said that there was a possibility of an agreement being arrived at between the promoters and the opponents.

After the luncheon interval, Mr. Moon said that negotiations had been going on between the parties, and the result was that the promoters had agreed with the company owning the estate proposed to be crossed by the tramway, to divert the route 150 yds. south of the original proposal.

Mr. Pollock said that the route, as proposed, would shorten the line, and would certainly be better. As there were other opponents for whom he appeared however, and as he did not know what view they took, he asked the Chairman of the Committee to adjourn for one day so that they might be consulted in the matter.

The Chairman thought that the time might be occupied by the engineering evidence. Accordingly Mr. Sellon, the chief engineer to the British Electric Traction Co., was called. He gave evidence with regard to the width of certain parts of the route.

On 18th inst., Mr. Sellon was re-called, and put in a plan showing the proposed alteration of route, which he explained to the Committee. He said that the proposal would have the effect of shortening the route. This concluded the case for the promoters.

Mr. Pollock said, that although the Carshalton Park Estate Co. agreed to the proposal, several of the remaining frontagers, for whom he appeared also, objected to it. He proposed to call witnesses to show that the tramways would be detrimental to the best interests of the locality.

A Mr. Tylor, a solicitor, resident at Carshalton, was then called. He said that Carshalton was a purely residential district, though there were workmen living in the neighbourhood. The effect of the tramways on the working population would, he said, be that of raising rents very considerably.

Mr. Barrow, another resident of Carshalton, gave similar evidence against the tramways.

After conferring, the Committee found the preamble proved.

Harrow Road and Paddington Tramways.

This Bill came before Sir Edward Strachey's Select Committee of the House of Commons on 17th inst. The promoters' case was opened by Sir Ralph Littler, K.C. Originally the Bill sought to empower the Harrow Road and Paddington Tramways Co. to construct two short lines of tramway, one in Cambridge Road, Kilburn, and another from the junction of Cambridge Avenue with

the High Road, Kilburn. Those tramways, however, were struck out in compliance with the resolution of the Select Committee on Standing Orders on March 10th last. The Bill as it came before the Committee therefore was limited to the question of working the existing tramways by electric power. The proposal was to adopt the overhead trolley system. Opposition to this came from the London County Council, who contended that they should have a voice in the matter of what system should be adopted. Their grounds were that there might be in the future a connection with the existing L.C.C. system, part of which is on the conduit system, and that they had the right to purchase in the year 1907.

Mr. Sellon, the chief engineer to the company was called, and gave evidence as to the various proposals.

Mr. Devonshire, managing director of the Metropolitan Electric Tramways, to which company the applicant company propose to lease the undertaking, said that there would be no difficulty in getting electric power, as there were the local authorities who could supply them. If the line were electrically equipped it would greatly increase its value to the travelling public.

On 18th inst., Mr. Talbot having addressed the Committee on behalf of the London County Council's case, the chairman ordered the room to be cleared. After deliberating for some minutes, the Committee found the preamble of the Bill proved, and the consideration of clauses was proceeded with.

The Municipal Trading Committee.

Sir Samuel Provis, Permanent Secretary of the Local Government Board, gave evidence before this Committee, presided over by Earl Crewe, on Monday. He gave statistics of the municipal loans granted during the years 1900, 1901 and 1902. The electric lighting loans were £10,226,000, in addition to £1,427,000 authorised by local Acts. For telephone systems the loans sanctioned amounted to £114,000.

On March 31st, 1901, which were the latest figures available, the total outstanding loans were as follows:—

Electric light	...	...	1898	... £3,674,000
"	...	...	1901	... 11,066,000
Tramways	...	...	1885	... 1,167,000
"	...	...	1998	... 3,255,000
"	...	...	1901	... 8,091,000

The total outstanding loans for all purposes amounted in 1901 to £172,983,000.

Sir George Bartley questioned witness at some length as to the advisability of enacting that all municipal accounts should be set out in the same form as any commercial undertaking, and should be certified by a firm of accountants. He asked whether it was a fact at present that the electric lighting accounts of municipal bodies were not so set out, and that it was really impossible for ratepayers to tell how the undertaking stood.

Witness said that in the case of a municipal electric lighting undertaking the accounts would show the sum spent during the year upon the undertaking, but it would not give a balance-sheet. It was not kept on what would be called commercial lines, and would not show a profit and loss account. With regard to this being done, it raised an important question which was being considered at present by the Local Government Board. He thought that some modification of the present system was desirable, but there were difficulties with regard to the accounts being certified by a chartered accountant. He would prefer that the auditors should be Local Government auditors. There were at present four towns whose accounts were compulsorily audited by the Local Government Board. Many municipalities published their accounts in volumes, so that the results of their operations could be ascertained. At present municipal accounts were kept in varied forms, and no doubt it would be better if they were kept in a uniform manner.

Mr. Alfred Grey, counsel to the Chairman of Committees in the House of Lords, was next examined, and said an effective system of municipal audit would go far to remove the evils resulting from municipal trading.

Mr. T. A. Welton, a past president of the Institute of Chartered Accountants and Chairman of the Finance Committee of the Wandsworth Borough Council, said he agreed with the last witness that it was to the public interest that local authorities should appoint their own auditors, but subject to the approval of the Local Government Board. He did not think it would be possible to lay down a standard form of accounts, but it might be possible to lay down certain principles which should be followed in drawing up accounts. They might have separate forms of accounts for particular enterprises. A separate balance-sheet should be published of each enterprise—in fact, he would treat municipal undertakings just the same as a private company. The transfer of receipts and balances from one undertaking to another was open to great objection, and he would not allow it, except with the consent of the Local Government Board. The work required to be done in the interest of any undertaking should be placed to the debit of that undertaking. In the case of a tramway undertaking, where street widenings had to be done, he would refer the matter to the auditor to say as to what proportion should be charged to the tramway undertaking. The question of depreciation was a most important one. The allowance ought to represent the wastage on the actual capital, and very often ought to include a provision in cases where the works were liable to become obsolete. Establishment charges, he thought, needed to be extended in the case of many municipal undertakings so as to make each undertaking contribute its share of the general salaries.

The Committee adjourned until Thursday.

Mid-Yorkshire Tramways Bill.

A Select Committee of the House of Lords, presided over by the Earl of Donoughmore on June 15th, commenced the consideration of the above Bill, which seeks to incorporate the Mid-Yorkshire Tramways Co., with a capital of £372,000, and to authorise the company to carry out a number of tramways in the Keighley district of Yorkshire. Mr. Fitzgerald, K.C., and Mr. Macassie represented the promoters. The Keighley Corporation were represented by Mr. Freeman, K.C., and Mr. Waugh, and the London and North-Western Railway Co. by Mr. Baggallay and Mr. H. Lloyd.

Mr. Fitzgerald, K.C., in opening the case for the promoters, said it was the object of the Bill to construct tramways along the valleys of the Aire and Wharfe. At the present time there was a line of tramways from Bradford to Shipley, and it was desired that power should be given for the construction of tramways from Shipley to Keighley on the one side, and from Shipley, *viâ* Baildon, to Menston, Otley, Ilkley and intermediate places on the other. Many of the inhabitants of the districts along the suggested lines of route worked in Keighley, Shipley and Bradford, and the lines would be of great convenience to them. Every local authority in the district had given consent except Keighley. The Corporation of Keighley had secured a provisional order to promote their own tramways in the borough, and the question which arose really was as to who should construct the tramways. The position of his clients was that if the Keighley Corporation made their own tramways within the borough, the company should be allowed running powers over them, and the terms upon which such powers should be allowed should be settled by the Board of Trade. Further, they asked that if the Keighley Corporation did not construct within the time prescribed by the Order, then the Mid-Yorkshire Co. should have power to construct within the borough. Even if the Mid-Yorkshire Co. constructed the tramways within Keighley, they were willing that the Corporation should have control of them. With regard to the London and North-Western Railway Co., their opposition was on the ground of competition, and he contended that such opposition could not be upheld in view of the action of Parliament in other cases.

Mr. Freeman, K.C., addressed the Committee on behalf of the Keighley Corporation, and said his clients did not want to prevent the construction of the through route, as they recognised the convenience it would be. All they objected to was strangers coming into the borough except on certain terms. They asked that, if running powers were granted, the company should be only allowed to run through cars, and should not be allowed to run a purely local service. Further, Keighley desired a clause inserted making it clear that if the question of terms went to arbitration, the Board of Trade should bear in mind the expense Keighley had been put to in widening streets for tramway purposes.

Mr. Fitzgerald saw no difficulty with regard to the first point, but could not accede to the second. He could not give an undertaking to fetter the discretion of the Board of Trade in case arbitration became necessary.

A number of witnesses were then called, including Mr. R. Quin, one of the promoters, who stated that 26 miles of tramways were proposed. He estimated that that company would almost at once pay 5½ per cent. dividend, and that the dividend would be progressive.

On June 16th Mr. Fitzgerald said there was every possibility of an arrangement being come to with Keighley, and in the meantime he asked that the opposition of the railway company might be gone into.

Mr. J. Mathieson, general manager of the Midland Co., gave evidence as to the prejudical effect the tramways were likely to have on the receipts of that line, and other evidence of a similar character was called.

Mr. Freeman then announced that a satisfactory arrangement had been come to between the promoters and the Keighley Corporation, by which the Corporation withdrew their opposition. The promoters undertook only to run a through service through the town, and leave the Corporation to work the local service, and also in assessing the amount to be paid for the use of the Keighley tramway lines they had undertaken that the arbitrator should be asked to take into consideration the cost incurred by the Corporation in widening the streets for tramway purposes.

The Committee found the preamble of the Bill proved, and ordered it to be reported to the House.

Birmingham and District Tramways.

On 18th inst. Mr. Emile Garcke gave evidence, describing in detail the various routes. With regard to the various sections of the tramways, he said that the British Electric Traction Co., the Birmingham and Midland Co., and the City of Birmingham Co. worked about 20 miles of line outside the city, radiating north and south. Witness stated that several times the companies had endeavoured to come to some arrangement with the Corporation, but never with success; therefore he considered the proper course had been taken in coming to Parliament. The proposal was to equip electrically all the lines, and to run them as one system with the outside lines. Although in 1899 the Corporation decided in favour of municipalisation, the next year they made arrangements with the companies for electrification; then, after further negotiations, they decided in May of this year to abide by their decision to municipalise the trams.

In answer to Mr. Balfour Browne, K.C.: If the Corporation were prepared to enter into working agreements, and to equip the line electrically, the promoters would seek further advice.

Mr. Wm. Shakespeare, town clerk to the Smethwick Urban Council, and other witnesses from that place, gave evidence in favour of the Bill.

A large number of local witnesses were called on Friday, mostly the chairmen and clerks of the various Councils interested in the Bill.

Col. Ludlow, surveyor to the Board of Trade, said that several years ago he reported on the Birmingham tramway system. He was of opinion that the tramways would greatly benefit the working class population, for whose accommodation large estates had been laid out in the surrounding districts. But the service of trams would have to be a continuous one.

Mr. Fitzgerald, in reply to a suggestion from the Chairman, said that the promoters, after careful consideration, desired to submit a proposal that a clause be inserted providing for through communication between Birmingham and the adjoining districts, the terms and conditions to be settled by an arbitrator to be appointed by the Board of Trade. He thought that that might be a basis for a settlement of the whole matter. Mr. Balfour Browne, K.C., reserved his answer to this until Monday.

On Monday Mr. Lloyd said that he was afraid the case would have to be proceeded with as it stood, as no agreement had been come to with regard to the clause which it was suggested should be inserted in the Bill, leaving it to the Board of Trade to find a solution satisfactory to all the parties. The view of the Corporation was that if any such step were taken there should be excluded from the consideration of the Board the proposal as to running powers. As the promoters were willing to submit the whole matter to the Board of Trade, he contended that it would be improper and inconvenient if one of the most important provisions of the Bill were excluded from consideration.

Mr. Balfour Browne, for the Corporation, said that the point was that through communication between Birmingham and the surrounding districts should be agreed to as a basis of a settlement of the contentious matters. The promoters were asking for running powers over the Birmingham lines and the Birmingham Corporation objected. Counsel's speech lasted all the morning. After lunch a number of witnesses were called in support of the opposition, including Alderman Beale, the chairman of the Tramways Committee of the Corporation, and Alderman Cook. After lengthy examination and cross-examination, the chairman of the Committee intimated that the Committee did not wish to hear any other evidence.

The Committee room was then cleared. After conferring for some minutes in private, the Chairman announced that the Committee found the preamble proved as regarded the tramway. The clauses were settled on Tuesday morning.

Leeds Tramways Bill.

On Tuesday a Select Committee of the House of Lords under the chairmanship of the Earl of Belmore, considered Tramways Orders Confirmation (No. 1) Bill which contained the confirmation to the Leeds Corporation of an extension of their system.

Mr. Balfour Browne, K.C., who, with Mr. Ram, represented the promoters, described the tramways which the Corporation sought power to construct, which were altogether about eight miles in length. The only opposition came from the London and North-Western Railway, who asked for a protective clause with regard to the carrying of an electric wire under a bridge belonging to the company in Domester Street. The company alleged that there would be danger of injury to their workmen when the bridge was repaired. He submitted, however, that the space beneath the bridge was absolutely the property of the public, and the Corporation were simply dealing with their own property. The Railway Co. had no right without the consent of the Corporation to come underneath the bridge to repair it, but when a question arose between two great Corporations, they would like to act reasonably. There were 13 railway bridges in Leeds under which there were electric wires for the tramways, and three of these belonged to the North-Western Railway Co. In none of these cases were there any protective clauses. Whenever it was wished to repair these bridges the Corporation cut off the current at night.

Mr. J. B. Hamilton, manager of the Leeds tramways, said that 80 miles of tramways were now being operated in Leeds. They went under 13 bridges, and in no case was there any protective clause.

In cross-examination by Sir R. Littler, K.C., Witness admitted that if the railway company was to have any voice, the suggested clause was reasonable.

The Chairman asked if there was any body to which an appeal could be made in the event of a disagreement as to what was a reasonable time for cutting off the current.

Sir R. Littler said the Corporation had made no objection to details. They simply said they would do nothing. The company had no objection whatever to an appeal to the Board of Trade in the event of a refusal by the Corporation. All the company wanted was that they should not be put at the mercy of the Leeds Corporation.

Mr. Hopkinson, consulting engineer to the Leeds Corporation, said there were 5 ft. between the live wire and the structure of the bridge. They could make it up to 8 ft. if necessary, which would enable the company to paint their bridge. They were willing to keep the wire down to 8 ft.

By Sir R. Littler: He could not imagine the Leeds Corporation being unreasonable.

Can you imagine the L. & N.W. Railway being unreasonable?—Yes, I can—they are not acquainted with the conditions of our traffic.

The Committee passed the preamble, subject to the insertion of a clause protecting the railway company. By this clause the Corporation will be bound to cut off their live wires at reasonable times when requested for the repair of the bridge, and any dispute as to what shall be a reasonable time will be settled by the Board of Trade.

North Metropolitan Electric Power Supply Bill.—On Monday the above Bill, which has just been introduced, came before the Examiner for Proof of Compliance with Standing Orders, and it was found that the Orders had not been complied with. Accordingly it will be referred to the Standing Orders Committee, who will decide whether the Bill will be allowed to proceed. The Bill empowers the U.D.C. of Willesden to sell their generating station to the company, and the company will be empowered to enter into agreements to supply electricity in bulk from the station to the District Council, to the Harrow Road and Paddington Tramways Co., and to any new tramways or light railways within the area owned or worked by the Metropolitan Electric Tramways Co., Ltd.

Hastings Tramways (Extensions).—On Tuesday this Bill came before the Select Committee of the House of Commons, presided over by the Deputy-Chairman. The Bill empowers the Hastings Tramways Co. to construct extension tramways in the county borough of Hastings. It is proposed to construct new tramways to the length of 2 miles 6 furlongs, at an estimated cost of £26,161. Power is taken to raise £60,000 additional capital. The preamble of the Bill was found proved, and it was ordered to be reported to the House for third reading.

Tynemouth and District Electric Tramways (Extension).—This Bill authorises the Tynemouth and District Electric Traction Co., Ltd., to construct additional tramways and other works, and to use electric power for the tramways. It is proposed to construct 2 miles 4 furlongs odd of tramways at a cost of £35,021. It gives the company running powers over the lines of the Tyneside Tramways and Tramroads Co. On Tuesday it came before Mr. Jeffrey's Committee of the House of Commons, and there being no opposition, it was ordered to be reported for third reading.

New Group.—A new Select Committee has been appointed, consisting of Messrs. Bond, G. Brown, T. L. Corbett and C. Devlin, to consider the following group of Bills:—Dudley, Stourbridge and District Tramways; London, Brighton and South Coast Railway; Pontypridd U.D.C.; Preston, Chorley and Horwich Tramways; South Lancashire Tramways; Bournemouth Corporation Tramways; Poole and District Electric Traction; Hove, Worthing and District Tramways; and South-Eastern and Chatham and Dover Railway.

Electric Lighting Provisional Orders (No. 7) Bill.—This Bill came before the Unopposed Committee of the House of Commons on Thursday last week, and was ordered to be reported for third reading. It confirms orders granted by the Board of Trade to the following districts:—Cambridge; Isle of Sheppey and District; Sandwich; Deal and Walmer; Sittingbourne and Milton; Strood and Dartford Rural Districts; Tadcaster and District (Extension); Uxbridge and District (Extension), and Wimbledon (Extension).

Wigan Corporation Tramways.—On Thursday the Examiner found that Standing Orders had not been complied with in the case of the above Bill, and accordingly the Bill will have to go before the Standing Orders Committee.

Standing Orders.—On Friday Standing Orders in the House of Commons were found to have been complied with in the case of the Willesden U.D.C. Bill, the Fyfe Electric Power Bill, and the Nottinghamshire and Derbyshire Tramway Bill. In the case of the Rochester Corporation Tramways and Improvements Bill Standing Orders were found not to have been complied with, and the matter will have to go before the Standing Orders Committee.

Keighley Tramways.—On 16th inst. the provisional order granted by the Board of Trade to the Keighley Corporation, and contained in Tramways Confirmation Bill (No. 2), came up for consideration. Mr. Freeman, K.C., appeared for the promoters, and called Mr. W. H. Hopkinson, borough engineer, who gave formal evidence, and stated that the object of the order was to construct a new tramway from the centre of the town to Stockbridge, and to electrify the existing horse tramway between Ingrow and Utley. There was no opposition, and the Committee found the preamble of the order proved.

Hove, Worthing, and District Electric Tramways.—The Standing Orders Committee of the House of Commons have decided that Standing Orders may be dispensed with in the case of this Bill. Mr. L. Sinclair has given notice of his intention to move the rejection of the Bill on second reading.

CORRESPONDENCE.

Free Trade v. Fair Trade.

I note, with great satisfaction, that you have opened your columns to the expression of opinion on the great question of Free Trade *versus* Fair Trade. It seems a most extraordinary thing how little the principles of trading are understood by the ordinary man in the street, or at least the man in the street who exploits his convictions, apparently, without having grasped the rudiments of the question to the smallest degree. Everyone must agree, unless he is an utter simpleton, that it would be vastly to the country's benefit, other things being equal, if the 100 millions of pounds'

worth of manufactured goods alone bought annually by this country, were manufactured in this country, in British factories, and by British labour. In the electrical trade alone one million pounds' value of manufactured stuff is being annually imported, which, if manufactured in this country, would be sufficient to keep five additional factories going employing 1,000 hands each, at some 30s. to £2 per week per hand, and this only accounts for £1,000,000 out of the £100,000,000. On this basis, which is in no way an exaggeration, if this country manufactured the whole of the manufactured goods now imported into it, in addition to what it already manufactures, we could find employment, first hand, for some 400,000 to 500,000 more British working men, at an average wage of 30s. per week, and, second hand, at least half as many again, at the lowest estimate.

The whole question, although it is of most vital importance to the future prosperity of the country, and ought to receive the greatest amount of intelligent thought that the country can bring to bear on the subject, is treated by many in a spirit of derision, and by others simply as a political question, that is, a question on which it is easy to farm out the well-worn cry of the big and little loaf, &c., with effect, for the sole idea of displacing the present Government and substituting themselves, on the strength of the want of perception of the average voter.

Like your correspondent who signs himself "Free Trader or ——?" the bulk of the men in the street cannot see how they would be anything but losers, except they are manufacturers, whereas the writer contends that practically everyone would be immense gainers. Would it be no benefit to "Free Trader or ——" if, say, five additional electrical factories requiring assistants sprang up employing 1,000 hands, or, say, 10 smaller ones employing 500 hands. Or would it not be better, say, for the proprietors of the electrical technical papers if this £1,000,000 extra value of electrical machinery were manufactured in this country. Assuming only that 1 per cent. was expended by the manufacturers in advertising this amount of extra sales, it would mean £10,000 per annum extra in the pockets of the technical press proprietors, and 1 per cent. of sales expended in advertising would not be out of the way as an estimate. Perhaps they consider that they already get this amount due to the advertisements of foreign electrical machinery, in which event the contention would not hold good; but in any event it would be much more to their satisfaction, the writer would think, if it came from the sale of British goods made by British working men.

If we could open a trading account with the moon to the extent of £100,000,000 per annum, everyone would go off their heads about it and think the millennium had come; yet here we have this amount, which is the country's birthright, going under our very noses, and being treated as a matter of derision and ridicule.

H. W. Wilson.

Stowmarket, Suffolk,
June 19th, 1903.

Zollvereinism.

Technical journals are not supposed to take part in ordinary political discussions, and in considering the new fiscal proposals that threaten a return of the old Free Trade and Protection controversy, they can only deal with the question as it affects the electrical industry. Until the, at present, vague ideas take shape and get out of the region of party cries into the concrete form of a Bill in Parliament, we are all necessarily in the dark as to what is really intended.

The Imperialist idea appears to involve a policy of trade combination in the interests of the United Kingdom and her Colonies. Trade between the Mother Country and Colonies is to be cultivated by preferential Custom House arrangements.

The British Empire is to regulate its fiscal policy on the principle of absolute reciprocity, Free Trade being established with exceptional arrangements as to foreign Protectionist nations.

The scheme assumes that the Colonies will adapt their fiscal policy to that of the Mother Country in all respects, and that foreign nations will continue to impose duties upon the produce and manufactures of the British Empire. With universal Free Trade, of course there would be no *raison d'être* for retaliatory measures. If such a policy were carried out, what would be the effect upon the electrical industry?

It appears to be agreed by the promoters of the system for which we have coined the word Zollvereinism, that food and other necessaries will increase in value, but that wages will also increase to a greater degree. Thus the electrical industry will be carried on at higher rates of wages, while the cost of all materials will be enhanced by the limitation of the sources of supply, or the additional charges imposed upon importations from foreign nations.

The supply of electrical manufactures to foreign countries, will be also affected by the extra cost of production and additional difficulty experienced in competing for business.

We do not know if the Imperialist idea extends to the question of the establishment of aliens in the British Empire, but if they contend that Americans and Germans should not carry on their extensive electrical manufacturing works within the Imperial territories, it would involve some startling developments. The electrical industry in this country owes much of its practical working to the inventions and energy of foreigners, especially the Americans, as represented by Brush, Thomson-Houston, Westinghouse, Edison and others, with Siemens and Schuckert among the Germans, all of whom are established in this country.

If preferential duties in favour of the Colonies are imposed, it will mean paying more for copper, which enters so largely into all our electric work, for South Australia and even Canada would claim exceptional advantages over South America and Spain. Canada manufactures dynamo machines, and under a preferential tariff it might add to the cost of such appliances if obtained from America or Germany, although the chances of any important development of the Canadian supply of the article for British and Colonial consumption would be somewhat remote.

Again, there is the matter of lamps, millions of which are imported into this country free of duty from Germany, France, Holland, Norway, Switzerland, &c., so that if the proposed arrangements put on any extra cost, it could not benefit the industry by making preferential terms in favour of Canada, for example, where electric arc and incandescent lamps are made by American firms domiciled there.

One of your contemporaries which favours preferential duties to use as a leverage in bargaining with Protectionist countries, uses the argument at present adopted by Mr. Chamberlain that it would tend to promote Free Trade all round. That is to say, if we put on a retaliatory duty and then say to the foreigner we will take it off again if you take yours off too; they are more likely to alter their fiscal arrangements than if we leave them alone, but this argument assumes the whole question of whether Free Trade benefits the nation which adopts it, whatever course other Powers may pursue.

The Protectionist countries might content themselves by congratulating this country upon having adopted their enlightened views and adhere more strongly to them. When Free Trade was being advocated for this country its advantages appeared to be so apparent that it was believed that our example would convert the rest of the nations, but triumphs of progressiveness are not so easily obtained. It required an immense effort to bring about the change among Englishmen, and there are still among us those who cling to the old Protectionist theories, and preach them under the names of Reciprocity and Fair Trade; but the general interests of the community will prevail, and the argument of high prices resulting in better wages is already received with the sceptical but very practical suggestion that the improved wages had better be secured first before doing anything to increase the cost of living.

Among those who have expressed opinions, a late President of the Institution of Electrical Engineers considers that Free Trade between the Colonies and the Mother Country, with a certain impost on importations from other countries, would not affect the price of food and would benefit the electrical industry, but he does not show how this would be accomplished, and his views are certainly not in accordance even with those of Mr. Chamberlain, who admits the probable advance in cost of living, but suggests higher wages to enable people to pay for it, in which case those who have fixed incomes and are not subject to the rise and fall in wages will not receive

the new policy with much comfort. Nor does he explain how any restriction on imports can improve the electricity business.

Prof. Silvanus P. Thompson argues strongly against the proposal, and considers that to the electrical industry it means its concentration in the hands of financial trusts and rings both abroad and at home, but while agreeing with him in his opinion of the baneful results of the change, we do not quite follow his conclusion as to the effect upon the character of the organisations for carrying it on.

Mr. W. C. Mountain tells a sad tale. A *Conservative (!)* Member of Parliament has actually adopted the old commercial axiom of buying in the cheapest market instead of paying a higher price to Mr. Mountain's firm. Most unpatriotic indeed! but how does he expect to persuade the community that it is in their interest to pay more for what they want than market value? If this is the best argument he can give, then this mountain in labour has indeed brought forth a very poor little mouse.

Mr. Tinker is on safer grounds when he appeals to results as proving the soundness of the views of the veterans of the Free Trade policy, of whom, by the bye, Mr. Chamberlain was one, and Lt.-Col. Crompton endorses his opinion, with the warning that any restriction whatever on trade is a mistake, and will prove financially disastrous to this country in the long run.

If foreign manufacturers are foolish enough to sell us their goods, be they electrical apparatus or sugar, at a loss to themselves, it is a gain to us; and to cut off our nose to spite our face by trying to stop the process, will not help matters.

The Two Obadiahs.

In reading "Free Trader's" reply to my note, I observe with pleasure that in principle he revokes his utterances, and reveals himself as a "real Free Trader," and not a "selfish Protectionist."

In view of the statement by a hard-shelled Protectionist that higher wages and salaries are paid abroad than here, there would hardly appear to be any necessity to levy imposts on the hated foreign engineer, as under these conditions it would only be prejudicial to his interests to come over here at all.

It seems to me that "Free Trader" and a good many others do not know what it is they do want, and to please them all the Government's only course would be to legislate specially for each individual manufacturer, engineer, &c.

Undeluded.

June 22nd, 1903.

Electricity in Mines.

I note Mr. Simons's letter in your current issue, and having recently installed what is probably the largest three-phase power plant for colliery work in this country, I might claim some knowledge of the matters which Mr. Simons apparently thinks I lack.

I am quite aware that three-phase motors of comparatively small size are built for pressures of 3,000 volts, and I would not hesitate to instal such in suitable places, but what I contend is that a coal mine—such as we have in this country—is not a suitable place.

Mr. Simons says open-type motors can be used, and I quite agree that this is the better type to use where possible, but not at 3,000 volts in a coal mine.

If this gentleman has been underground much, he will know that the air is impregnated with moisture and the coal dust collecting on the windings is more or less damp. Now the risk of breakdown of the coils insulation is directly proportional to the pressure, and it would not be long in proving a constant source of trouble and danger. However undesirable these conditions may be, they are nevertheless unavoidable, and keeping the pressure down is the only way, in my opinion, to ensure reliability from breakdown.

With regard to switchgear, I have used switches entirely immersed in oil and in gas-tight cases with every success. These switches operate on 600-volt circuits, motors requiring 150 amperes per phase. This question of switchgear, as Mr. Simons says, is very important, but at low pressures it does not present great difficulties in colliery work, for the simple reason that in this country motors of over 300 H.P. are rarely required underground. Consequently, the currents to be handled will be in the order of 300 amperes per phase at 500 volts. It is not difficult to build switches for this current—or even double.

The question of cost of copper is a secondary consideration when the distances are short, and the fixing of large cables in shafts presents no difficulties to those accustomed to this class of work. I have put cables 3 in. diameter by 300 yards long into a shaft in a few hours.

Electric plant at a colliery must require a minimum of attention and repairs, otherwise it will lose many of its advantages. If we increase the pressure to save a few pounds in first cost of copper, and by so doing increase our risk of breakdown and attention necessary, it will be a fatal policy both for the collieries directly concerned and the development of electric power in this class of work generally.

W. A. Scott.

Cardiff, *June 20th*, 1903.

Bankruptcy Proceedings.

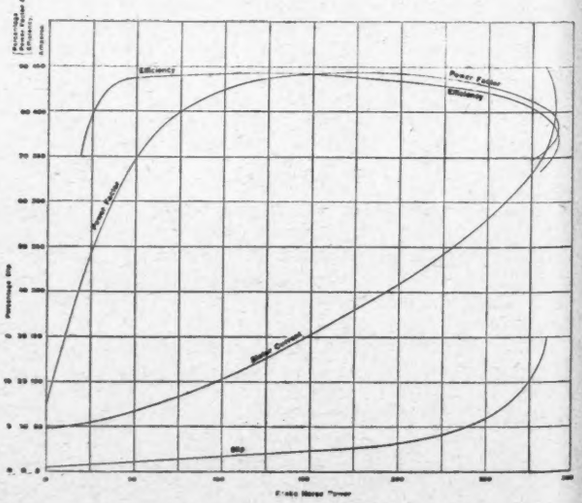
I much regret seeing the prominence given in your issue of 12th inst. on page 1003 to my unfortunate position. I now ask you, with your usual fairness, to note the following:—No actual proceedings took place at all, and the party furnishing the garbled report might have stated—(1) the true names of creditors; (2) that, with the exception of about £150 unsecured, all the liabilities are due to a law-suit; and (3) that the assets are over £700. I ask for this explanation considering my old standing in the trade (I have been in business on my own account for 20 years), and owing to the pioneer work I had to do, had many a hard struggle. When competition became too keen I saw to it that the trade received 20s. in the £, sacrificing everything to do this. A careful inspection of the report proves same. Not a trade name appears.

Harry South.

June 23rd, 1903.

LARGE LOW-SPEED INDUCTION MOTORS.

We have received from Messrs. Witting, Eborall & Co., Ltd., the following interesting particulars of some special low-speed induction motors, which have been recently supplied for mining work. The problem presented to the makers was that of replacing three steam engines driving mining pumps, by means of electric motors of corresponding output, namely, 150 B.H.P., working from a three-phase supply at 21 cycles. The speed of the mining pumps in question being only 68 revolutions per minute, and the motors having to be directly coupled to them, the difficulty of the problem from the electrical point of view will be readily appreciated. At 21 cycles,



Curves of Efficiency, Power Factor, &c.

the speed of 68 revolutions per minute corresponds to 36 poles on the motor, and this called for a rotor diameter of 9·6 ft. in each case. On account of the clearance between rotor and stator being of the order of 0·07 in., this large diameter necessitated a special construction in order to obtain the necessary stiffness in the motor, as any want of rigidity in either stator or rotor would be fatal to the proper mechanical performance of the plants under these circumstances. The illustration gives a good idea of the completed motor, and shows how the necessary rigidity is obtained; the rotor bearings are carried by special end shields consisting of spider-shaped castings bolted to the stator frame along its whole periphery.

The rotor is, of course, provided with the usual star-connected three-phase winding, the ends of which are connected up to three slip rings for the purpose of inserting a non-inductive resistance in the rotor circuits at starting. As can be seen from the figure, the brushes pressing on these rings are provided with an arrangement whereby the rings can be short-circuited and the brushes lifted off them after the motor has attained full speed. This obviates, of course, all wear on the rings and brushes while the motor is running, and also the loss in the cables going to the starting resistance which have to carry heavy currents.

The curves on the opposite page show the running performance of one of these motors, from which it will be seen that the power factor, efficiency and overload capacity are exceptionally good when the low speed of the motor is considered.

On account of the very large radiating surface, the temperature rise of the motors after long periods of running at full load is exceedingly small.

These three motor-driven pumps all work underground, and are giving every satisfaction.

THREE-PHASE MOTOR FOR MINING PUMP, 150 B.H.P.; 68 REVS. PER MIN.; 21 CYCLES; 350 VOLTS AT THE TERMINALS.

BUSINESS NOTES.

Electrical Wares Exported.

WEEK ENDING JUNE 24TH, 1902.

Adelaide	Value £63
Alexandria	22
Amsterdam	62
Bilbao	181
Buenos Ayres	1,614
,, Teleph. cable	205
Calcutta	591
,, Teleg. wire	111
Cape Town	188
,, Teleg. mat.	375
Channel Islands	181
Colombo	201
,, Teleg. mat.	451
Durban	2,936
Fremantle. Teleg. wire	189
Gibraltar. Teleg. mat.	15
Hong Kong	334
Melbourne	405
New York	500
Perth	60
Port Elizabeth	66
Shanghai	270
Sydney	2,165
,, Teleg. wire	160
Townsville. Teleph. cable	528
Wellington	60
Yokohama	428
Total	£12,221

WEEK ENDING JUNE 23RD, 1903.

Adelaide	Value £112
,, Teleg. mat.	52
Alexandria	72
,, Elec. launch	90
Amsterdam	21
Bombay	77
Boston	15
Brussels	90
Calcutta	1,604
Callao. Teleg. cable	7,500
Cape Town	107
Channel Islands	611
Colombo	85
Constantinople	48
Delagoa Bay	29
Durban	1,226
,, Teleg. mat.	657
Flushing	20
Hamburg. Teleg. mat.	120
Hong Kong	64
Kobe	581
Lyttleton	260
Madras	93
Melbourne	14
,, Teleg. mat.	45
Montreal	120
Penang	45
Perth	30
Port Elizabeth	96
,, Teleg. mat.	488
Rio Janeiro. Teleg. mat.	200
St. Petersburg. Teleg. wire	34
Shanghai	200
Singapore	220
Sydney	331
,, Teleg. mat.	26
Tientsin	10
Toronto	156
Valparaiso	35
Wanganui	45
Wellington	260
Yokohama	677
Total	£16,435

Foreign Goods Transhipped.

Boulogne. Elec. cable	Value £400
Brussels. Elec. goods	30
Total	£430
Gothenburg. Elec. goods	Value £129

Henley's New Works.—The *Gravesend and Northfleet Standard* of June 13th contains an account of an interview with Mr. Geo. Sutton, the enterprising manager of Henley's Telegraph Works Co., respecting the new works which that company is proposing to put down at Crete Hall Estate.

Holidays.—A very attractive "Tourist Guide to the Continent," has been issued on behalf of the Great Eastern Railway, detailing the new tours in North Germany, the Tyrol, Norway, Denmark, Sweden &c. It is published at 30, Fleet Street, E.C. (6d.), and as the return of fine weather will incline the thoughts of many in the direction of holidays, it comes at the right moment.

Catalogues and Lists.—From the A.B.P. ACCUMULATOR CO., LTD., of Stockton-on-Tees, we have received an advance copy of their new list of prices and outputs of their different types of cells for traction, central station, yacht lighting, and other purposes. It is of handy size, and attractively illustrated and arranged. Another list from the same firm consists of a set of illustrated sheets showing photographic views of the battery rooms at the Dartford, Devonport, Mexborough, Barnstaple, Worcester, and Oban Electricity Supply Stations, where A.B.P. batteries are in service. Other illustrations show different views of the plates of the Stockton type of accumulator.

A small pamphlet entitled "Angold Arc Lamps at Hornsey" has been brought out by the GENERAL ELECTRIC CO., LTD. It gives a full account of the Hornsey electric street lighting, of which a description has already appeared in the columns of the ELECTRICAL REVIEW.

MESSRS. BELL BROS., of Manchester and Ravensthorpe, have issued a brochure containing an account—illustrated by a number of excellent pictures of plant installed by them—of their patent process for purifying and softening water.

A catalogue of band saw mills, single and double cutting, has come to hand from the WATEROUS ENGINE WORKS CO., LTD., of Brantford, Canada.

MESSRS CRESSWELL'S ASBESTOS CO., LTD, of Wellington Mills, Bradford, Yorks., who are spinners and manufacturers of all kinds of asbestos goods, recently commenced the publication of a monthly magazine known as the *Engine Room and Boiler House*. It has some chatty articles and notes, and at the same time serves as an excellent medium for keeping the Cresswell specialities before the notice of buyers and users of engine stores.

A list of the "Mallett" oil and steam separator has come to hand from MESSRS. FIELD, MALLETT & CO., LTD., of 38, Mincing Lane, E.C.

A handy little pocket address book (with alphabetically finger index) has been sent to us by the GENERAL INCANDESCENT ARC LIGHT CO, of 115—117, Cannon Street, K.C.

Trade Announcements.—Messrs. G. N. C. Mann and Co. have changed their address to 5, Bank Plain, Norwich. The change has been necessitated by increasing business. At the new address Messrs. Mann have purchased a large and imposing building, which they have fitted up as extensive showrooms, offices, workshops and stores. The firm has at the moment a very large amount of installation work in hand, including complete installations for two large asylums, a large theatre, over a dozen country mansions, and a number of public buildings, including churches, clubs, hotels, &c.

The Wheeler Condenser and Engineering Co. has removed from Queen Victoria Street, and has taken offices at Westinghouse Building, 2 and 3, Norfolk Street, Strand, W.C.

The Ajax Electrical Engineering Co., of Morley Road, Barking, is removing to larger premises (offices and showrooms) at 78, North Street, Barking.

Messrs. Willey & Co., Ltd., of Exeter, have taken premises at Cross Street, Barnstaple, where they will carry on an electrical engineering business.

Hudson-Bowring Lifeguards.—We understand that the Corporation of Glasgow has authorised the equipment of 100 cars with this form of guard, and the B.T.H. Co. has been instructed to alter all the existing lifeguards to this type

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Dissolutions and Liquidations.—A petition for winding up the Electric Tramways Construction and Maintenance Co. is to be heard in London on June 30th.

The Electro-Magnetic Traction Co. is winding up, with Mr. J. H. Howard, of Hamilton House, Bishopsgate Street, E.C., as liquidator.

A meeting of the Norwich Electricity Co. is to be held at Norwich on July 23rd to hear an account of the winding up from the liquidators, Messrs. F. W. Harmer and G. F. Buxton.

Messrs. F. M. Long, E. Schattner and F. W. Harmer (Schattner and Co., Norwich) have dissolved partnership.

On July 13th the public examination takes place at Carey Street in connection with the Desramaux's Automatic Water Softener and Purifier, Ltd., of Cheapside, Bradford. The persons to be examined are:—W. Elmore, W. Parker, J. T. Norman, T. H. Butt, S. Smith, R. J. Hannam, E. W. Townend, and J. L. Harrison.

Sentence.—At Bow Street the other day Otto Domon, a French subject, described as an electrical engineer, was charged with obtaining money from Mr. Frederick Arthur Glover, electrical engineer, Garrick Street, Mr. J. E. Taylor, electrical engineer, Lombard Street, and other persons, by falsely representing that he had the placing of a large contract for electrical works on behalf of Mr. John Mitchell, pen manufacturer, Birmingham. Prisoner was sentenced to three terms of three months' imprisonment, or nine months in all.

Jandus Lamps.—The Jandus Arc Lamp and Electric Co. has recently placed on the market several new and improved forms of alternating arc lamps, double and single enclosed. The lamps are said to be remarkably quiet, this very important feature having been obtained without the use of rubber bands, &c., generally employed, as these quickly deteriorate owing to the variations of the temperature of the lamps. The choking coils and transformers are external, and can therefore be easily adjusted for different circuits by the average wireman without in any way interfering with the mechanism of the lamp. The cases are removed without detaching the lamp from the support or leads. The dust-proof mechanism is enclosed within an easily removable machined metal casting, forming a perfectly air-tight construction and enabling the lamp to be used in almost any position, and at the same time reducing the possibility of breakdown to a minimum. The lamps can be run singly on any voltage from 80 to 2,000, or in series on 200 to 2,000 volts by the use of patent transformers, &c. Further particulars can be obtained from Drake & Gorham, Ltd., 66, Victoria Street, London, S.W.

The Elland Destructor.—The refuse destructor and steam generating plant erected by Meldrum Bros., Ltd., for the U.D. Council were formally opened on June 16th. The destructor is of Meldrum's patent "Simplex" type of two grates, with regenerator for heating the air for combustion, and other special features of this system. Attached to the destructor is a Lancashire boiler 30 ft. × 8 ft., to work at 200 lbs. pressure, the steam from which will be used for driving the engines in the electricity station now being erected on the site. A supplementary Babcock & Wilcox water-tube boiler is also provided, fitted with Meldrum's forced-draught furnaces, for burning cheap coal fuel. This destructor is intended to burn pressed sludge from the sewage works, along with ordinary town's refuse, in the proportion of two of the latter to one of the sludge. This mixture will be effectually cremated, and the builders of the destructor have guaranteed 1 lb. of steam from each pound of the mixed material burned.

Electro-plating.—Messrs. W. Canning & Co., of Birmingham, have just issued from the press an interesting handbook on electro-plating, polishing, lacquering, burnishing and enamelling. It sets forth in some detail the practical means which are at present adopted in this country for the electro-deposition of metals and the preparation and finishing of same. The various apparatus, plant, and material enumerated are of Messrs. Canning's manufacture; indeed, the book is intended to be read in conjunction with that firm's catalogue. One section of the list deals with the charging of motor-car accumulators from a plating dynamo, the method of doing this being described. In the directions and large quantity of practical notes and hints there is a great deal that will be instructive to those of our readers who are interested in the subject of electro-plating.

A Truck Obstruction.—At the City of London Summons Court on Friday William Roodwell, in the employ of the Charing Cross and City Electricity Supply Corporation, was summoned for causing a truck to stand longer than necessary for loading or unloading. Mr. Walter Frampton was counsel for the defence, and stated that in the event of the case being decided against defendant, it was the intention of the company to take it up to the High Court. After hearing the evidence, Dr. Crosby said he should adjourn the case, to see if the company, the Board of Trade, and the Corporation could not arrive at some satisfactory arrangement as to the hours during which the work should be done, and that would be more satisfactory than going to the High Court.

Forthcoming Book.—"Electrical Engineering," by E. Rosenberg, "A practical elementary text-book" will be shortly published in this country by Messrs. Harper & Brothers, and simultaneously in New York by Messrs. Wiley & Sons. The author is the chief electrical engineer at Messrs. Korting Brothers, Hanover. A large amount of space is given to alternating current engineering. Prof. W. W. Haldane Gee, of the Manchester School of Technology, and Carl Kinzbrunner, the lecturer on Electrical Engineering at the same school, are responsible for its rendition into English.

Aqua Glue.—We have received from the Aqua Glue Co., of 23, Brunswick Street, Liverpool, a descriptive circular of their preparation of which any desired consistency can be obtained, quick or slow drying, according to requirements. For electrical work it is claimed to be a perfect insulator, and can be used either by itself, or for making a quick drying impervious insulating covering over the rubber tape used when jointing wires. It is useful for filling up the backs of switches and electrical instruments, as it forms a non-cracking flexible compound, is proof against damp or corrosion, and is always ready in an exceedingly handy form, an important advantage being that it does not dry up in the tubes like rubber solution, but will keep indefinitely. It will also unite strongly the broken parts of a porcelain switch base, is a sticker for celluloid and similar substances, and very useful for medical coils. In pattern-making it has great capabilities; and in automobilism it is said to be a useful rapid remedy for short circuit and kindred troubles. Some other uses to which it may be put are mentioned in the circular, of which a copy may be obtained on application to the company.

Imports of Foreign Electrical Machinery and Apparatus.—The imports of foreign electrical goods and apparatus in this country during May last were the largest recorded so far this year, a total of £67,582 being reached, as compared with £61,864 in the preceding month, and only £53,361 in May last year. The value of the imports during the five months ending with May is given as £300,480, as against only £283,702 in the first five months of 1902. On the other hand, imports of foreign electrical machinery are on a reduced scale, being only £7,466 for May, bringing up the total for the first five months of the year to £260,505.

Russia.—La Compagnie Centrale d'Electricité de Moscow reports a loss of 233,508 roubles for the last financial year.

Canary Islands.—La Société d'Electricité de las Palmas reports a loss of £2,654 for the last financial year.

A B.I.W. Walking Race.—On Saturday afternoon last 48 members of the staff of the British Insulated Wire Co., of Prescot, started from the Wire Works Recreation Club for a walk round the district, over a distance of 15½ miles. The turn out aroused great interest in the town and district. The walkers were started and timed by Mr. J. J. Tickle. The best time was made by W. Gerrard, who reached home in 2 h. 15½ min. The second was J. Howell and the third J. Holland. Medals were awarded to the following, who finished in the order named:—J. Stott, J. Lyon, E. Worsley, J. Wignall, P. Yowd, J. Hunter, J. Farrell, C. Money, W. Brynn. A "veteran's prize" offered to those over 40 who completed the distance was won by Mr. T. S. Payne.

The Royal Show.—At this show, which closes on 27th inst., Messrs. Robey & Co. have a good display of engines of various types. They also show a well-finished model of a 200-KW. steam alternator with exciter. This model was accurately made to a quarter scale, and every detail was perfectly finished. The whole model was made so as to be able to work with compressed air, but it was shown at their stand in motion, being driven by a small electric motor coupled direct to worm gearing. A long-stroke horizontal fixed engine fitted with patent trip-expansion gear is also shown. A new Robey-Saurer oil engine can be seen running coupled direct to a dynamo. Among other engines on the stand is a high-speed vertical open-type engine, suitable for electric lighting purposes, and an improved gas engine, which, under test, is said to have given remarkably low results in gas consumption.

Messrs. Ruston, Proctor & Co., Ltd., are making a special exhibit of their machinery at the Royal Agricultural Show at Ealing. It includes a number of their oil engines, ranging from 4 to 30 B.H.P.

ELECTRIC LIGHT AND POWER NOTES.

Bath.—A L.G.B. inquiry has been held respecting the application of the Urban Sanitary Authority for power to borrow a further sum of £30,000, for the purpose of the electric light undertaking. The extensions include a new boiler-house, an engine-house, a retaining wall on the river side, 80 ft. long, one 500-KW. continuous current dynamo, an additional boiler, condensers, an iron chimney, feed pumps, and other accessories, including a crane, and additions to the switchboard. Mr. Manville, electrical adviser to the Committee, said he thought it would be sufficient for about two years, not more. Mr. H. T. Hatt, chairman of the Committee, explained that the profit in the last year would have been larger had not the cost of the public arc lamps been reduced from £30 to £24 a-piece, and had there not been exceptional expenditure in connection with the conversion of a portion of the system from alternating to continuous current. He forecasted for the present year that there would be a profit of £752. Mr. Evans opposed, and contended that it was useless to make any further outlay on the works. He regarded the £90,000 already obtained in loans as money thrown away.

The City Council has adopted a report of the E.L. Committee recommending the Council to serve notice on the Rural D.C. of its intention to apply for a prov. order to extend the present area of supply—an action rendered necessary by the passing of the Somerset Electric Power Bill.

Blackpool.—The accounts of the Corporation electricity works show that last year a net profit of £2,410 was made.

Bray.—Tenders for additional buildings at the electric light station were received by the U.D.C. and referred to the Electric Light Committee. The tenders for new plant were referred to Mr. Hammond, the consulting engineer.

Brentwood.—After considering the E.L. scheme prepared by Mr. H. W. Wilkinson, the Committee informed the U.D.C. that it could not advise the Council to proceed any further in the matter, it being felt that the cost, £20,000, was too great.

Cardiff.—The report on the past year's work of the electrical department shows that the gross receipts amounted to £9,885, and the net profit to £3,647.

Chorlton.—The Board of Guardians has decided to have the electric light installed in the new hospital buildings at Withington and the Cottage Homes at Styal.

Devizes.—A Committee has been appointed by the T.C. to consider the question of applying for power to establish electricity works.

Dublin.—The E.L. Committee, in a special report, recommends a series of revisions in appointments and salaries in connection with the new system, which comprises the generating station at Pigeon House, the distributing station at Fleet Street, and 25 sub-stations, with 500 arc lamps, in place of one generating station and five sub-stations in the old installation. It is proposed to increase the salary of Mr. M. R. Ruddle to £600, with a proviso that £50 per annum be added for every £1,000 net profit made by the undertaking, and rising up to a maximum salary of £1,000 per annum. The proposed appointments also include chief assistant, second assistant, and assistant engineer, main superintendents, and chief book-keeper, all from the present staff.

Dundee.—Preparations are being made to renew the whole of the cables in the central area of the City, and the engineer has received instructions to prepare specification and ask for tenders for the work of supplying the mains in the town.

Eccles.—The T.C. has received from the L.G.B. sanction to borrow £4,052 for the construction of a refuse destructor.

Ebbw Vale.—At a L.G.B. inquiry into the application of the U.D.C. for sanction to borrow £10,000 for electric lighting, it was stated that the Council intended to purchase energy from the South Wales Power Co. at 1½d. per unit. The Council has been in communication with the Board of Trade for permission to put overhead wires instead of underground cables, which would reduce the cost to £6,000. The Ebbw Vale Co. appeared in opposition.

Electric Lighting in India.—The local government of Macao has granted a concession for 30 years for the lighting of the city by electricity:

Gillingham (Dorset).—The P.C. has appointed a Committee to consider the advisability of introducing the electric light into the town.

Glasgow.—The Joint Committee of the tramways and electricity departments has agreed (1) that the total quantity of energy now to be taken from the tramways department by the electricity department (including the 150,000 units, or any increase of that quantity, taken from the Coplawhill sub-station under the arrangement of date April 10th, 1902) should be fixed at not less than 700,000 units; and (2) that it be remitted to the general manager of the tramways department to consider and report as to the price at which the quantity of energy to be taken from Pinkston station should be furnished to the electricity department.

Prof. Archibald Barr, of the Glasgow University, is in communication with the electricity department for one of the latter's small disused Willans & Robinson's engines in the Kelvinside electricity station, for use in the James Watt Engineering Laboratories at the university.

The electricity department has reduced the charge made to the Clyde Navigation Trust for the supply of energy at the Queen's Dock from 2d. per unit to 1½d.

The total amount borrowed by the department from the Corporation's loan fund for capital fund to date is £1,097,000.

Gravesend.—The T.C. has decided that the charges for electricity in future will be as follows:—To lighting consumers, 7d. and 2d. per unit on the max. dmd. system, or 5d. per unit on the flat rate; to power consumers, 2d. per unit. After June 30th discounts will be given:—To consumers whose quarterly account exceeds £10, 2½ per cent.; £25, 5 per cent.; £50, 7½ per cent.; £100, 10 per cent.

Greenock.—The engineer has reported that the cost of laying cables, &c., to supply the poorhouse, as well as the new fever hospital (which is to be erected on a site a few hundred yards from the institution) would be about £2,300. The E.L. Committee has decided to lay the cables on condition that the Parish Council guarantee a minimum payment for energy of £300 per annum for 10 years. The Corporation is also in communication with Grangemouth and Greenock Shipyard Co. regarding a supply of energy to that company's shipbuilding yard.

Grimsby.—A loan of £7,000 for E.L. purposes has been applied for by the T.C.

Hebden Bridge.—A L.G.B. inquiry has been held into application of the U.D.C. for sanction to borrow £10,260 for electric lighting purposes. There was no opposition. It was stated that land had been secured for the works. Provision had been made in the scheme for providing power for a light railway from Hebden Bridge to Keighley. The price to be charged was 5d. per unit for lighting and 2d. for motive power.

Huddersfield.—The E.L. Committee has resolved to apply to the B. of T. for a provisional order authorising the Corporation to supply electricity within the urban district of Golcar.

Italy.—The Märkische Maschinenbau Anstalt, of Wetter a/d Ruhr, Germany, has recently completed three 200-H.P. gas engines on the Delamare-Debouttéville system for the Società Minière d'Elba, on the Island of Elba. They are intended to utilise the waste gases of the blast furnaces, and to be used for electric lighting purposes.

Kingston-on-Thames.—At a recent meeting of the T.C. the following recommendations of the E.L. Committee were adopted:—(1) Alterations to the stokers of the Lancashire boilers. (2) The provision of an additional air and circulating pump for the new condenser. (3) The re-arrangement of the water pump for pumping from the well into the tank overhead. (4) The substitution of an alternating current motor for the stoker steam engine.

"The Committee recommends the Council to reduce the charges on the indicator system, so that, instead of continuing the present rate of 6d. for the first two hours daily, and 4d. afterwards, the charge for the first hour daily should be 7d., and afterwards 3d. per unit, the charge to be 7d. where the indicator system is not adopted, and the discount scale to be discontinued.

"The Committee further recommends that a canvasser be engaged to solicit custom and explain the advantages of electricity.

"In view of the large amount now sunk in the undertaking, some £80,000, and for the purpose of supporting the Committee and the borough electrical engineer in their endeavours to render the undertaking a paying concern, it would be a wise precaution to appoint an advising engineer, at a salary not exceeding £120 per annum, for period not exceeding three years, who should be required to exercise a constant supervision of the works."

Upon the failure of the electric light during the recent floods, the special main to the theatre was connected up and a supply of energy given within three minutes, the performance proceeding as usual.

Kingstown, Ireland.—At the last meeting of the U.D.C. the recommendation of the E.L. Committee favouring a contract with Messrs. Edmundson's E.L. Co., and the application for sanction to borrow £40,000, was up for consideration. After a lengthy discussion, an amendment, that the report of the E.L. Committee be referred back to the same Committee, was carried by 11 votes to 3.

Leeds.—The annual report of the Electric Lighting Department shows that the consumers for lighting have increased by 639 during the year, and there are 112 more consumers for power. The units sold during the year amounted to 4,448,650, as compared with 3,055,165 in 1901-2, an increase of 45·61 per cent.; for private lighting, 3,418,383 units; street lighting, 124,829 units; and power 905,438 units were sold. The average net price has fallen from 3·56d. per unit in 1901-2 to 3·02d. in 1902-3. The receipts from the sales of energy and meter rents were £56,013 15s. 11d., leaving a gross profit of £36,659 9s. 4d. After deducting £22,404 for interest and £12,871 for the redemption fund there is a surplus of £1,383. During 1902-3, 87 additional electric arc lamps were erected in the city.

Lichfield.—The T.C. has been notified that the gas company intends to oppose the application of the Council for an extension of the E.L. prov. order to include the villages embraced in the gas company's area.

London.—MARYLEBONE.—A deputation of ratepayers waited upon the Finance Committee of the London County Council last evening for the purpose of asking the Council to withhold its sanction of the loan which the B.C. is desirous of obtaining in order to purchase the local electric lighting system.

Mr. Edward White, J.P., L.C.C., introduced the deputation and presented a petition signed by a large number of ratepayers. He said that there was a widespread feeling against the extravagant proposal of a certain section of the Borough Council to spend £2,032,000 in the acquisition of the Metropolitan Electric Supply Co.'s local electric supply system. The value of the undertaking had been assessed by an arbitration tribunal at £212,000, with £100,000 for goodwill, notwithstanding that the company had lost no less than £60,000 during the 14 years of its working. Other subsequent expenditure made up the huge total of £2,032,000. The Marylebone ratepayers asked the Council to refuse its sanction to the loan.

Councillor Emery said it would involve an increase in the rates of not less than 1s. 6d. in the £ per annum.

Lord Welby, the chairman of the Finance Committee, L.C.C., said the Committee had fully considered the question. It recommended that the application be not granted, on the ground that the solicitor has advised the Committee that it is not possible for the Council to sanction the proposed loan without further statutory authority being given to the Borough Council authorising it to borrow.

POPLAR.—The B.C. has adopted the recommendation of the E.L. Committee to spend £1,923 on extension works as a provision for the next winter's supply.

HAMMERSMITH.—The accounts of the electric lighting department show that at the end of the year there was an accumulated balance standing to the credit of the revenue account of £3,814 2s. 8d. The B.C. has decided to light Askew Road, Paddenswick Road, Dalling

Road and Glenthorne Road by arc lamps affixed to the tramway standards, at a cost of £1,172 0s. 2d.

City.—The Council has approved the plans submitted on behalf of the Charing Cross and Strand Electricity Supply Corporation, Ltd., for the construction of an electricity distributing station on the south side of Beech Street, between Braime's Buildings and Three Herring Court.

Hackney.—The Electric Lighting Committee of the Borough Council reported on Tuesday that the feeder and distributing mains are becoming fully loaded in certain localities, and there could be no doubt additional feeders would have to be laid down next year. In the meantime it had decided in order to keep the pressure reasonably uniform during the coming winter to lay connecting distributing cables joining those parts of the network in which the pressure differs to any considerable extent. The estimated cost was £906.

Islington.—The Borough Council on Friday referred to the Lighting Committee a letter from the Stoke Newington B.C. asking for prices for the supply of electrical energy in bulk. It was decided to inform the L.C.C. that the Islington B.C. was strongly opposed to the proposal of the Holloway Electric Supply Co. to supply the new Marlborough Theatre by means of overhead wires crossing the Holloway Road. A recommendation by the Lighting Committee that application be made to the L.C.C. for sanction to borrow £4,125, and that the seal of the Council be affixed to a contract with the Electrical Construction Co., Ltd., for 37 transformers for £2,966, was referred back for more information, especially in regard to the cost of laying down the transformers. One councillor described the Committee as worse than the War Office. A private firm, he said, which managed in such a way would be bankrupt in 12 months. The Joint Finance and Lighting Committee recommended that the firms which originally tendered for the extension mains in the Hornsey Rise and Canonbury districts be asked to revise their tenders on the basis of further explanation supplied by the electrical engineer. Mr. Lambert, chairman of the Committee, disassociated himself from the recommendation. It was, in his opinion, a most improper proceeding, and other speakers concurred. Alderman Mills, in supporting the recommendation, said when they found they were paying too much for an article, it was right they should use proper and fair means to bring about a reduction. They hoped to save nearly £800. On a division the recommendation of the Committee was carried. A report by the Finance Committee to the effect that the regulations as regards ordinary and overtime pay at the electric lighting station were unsatisfactory, and recommending same, be referred to a special committee for revision, was carried. The Lighting Committee recommended that from the end of the current quarter the charge for supplying electricity to places of worship, public entertainment, hospitals, workhouses and infirmaries, be 4d. per unit for lighting, and 2d. per unit for power. This was adopted.

Llanrwst.—At the monthly meeting of the Llanwrst U.D.C. it was decided to pay the Llanwrst Electric Supply Co. the sum of £62 3s. 9d. for lighting the public lamps in the town through the last season. The lighting was reported to have been satisfactory. The tender of the lighting company for lighting was again accepted, the terms being 25s. per lamp from August 10th, 1903, to May 20th, 1904, the lamps to be of 50 c.p.

Mangotsford.—The Council has signed a petition in favour of the proposal of the Somerset E.L. Power Co. There are 9,000 inhabitants and no public lighting. The company propose to charge 3d. per unit for energy in bulk.

Mansfield.—The formal opening of the new electricity works took place on Wednesday afternoon, in the presence of a large and representative gathering of townspeople. The works are situated on a portion of Burden's estate, contiguous to the gasworks, and are approached by specially constructed roads. The buildings are of brick with stone dressings, and the undertaking consists of a generating station for electric lighting, power and traction, comprising a boiler house, engine and dynamos room, switch, accumulator and pump rooms, cable stores, workshops and the officials in charge and their staff. In the northern part of the buildings is the plant for the destruction of refuse. The boiler house contains three Lancashire boilers by Messrs. Musgrave & Sons, Ltd., of Bolton. Each boiler is 30 ft. long, by 8 ft. in diameter, and capable of evaporating 8,000 lbs. of steam per hour, and constructed for a working pressure of 160 lbs. per sq. in. The engines are triple-expansion, and are designed to develop 400 I.H.P., and direct-coupled to multipolar compound dynamos, designed for an output of 200 to 300 KW. A 10-ton overhead travelling crane by Messrs. Carrick & Ritchie, of Edinburgh, spans the engine room. A booster is provided for charging the battery. It consists of two machines, one running as a motor at 480 to 500 volts, and the other as a generator, designed to give a current of 160 amperes at any pressure from 20 to 160 volts, when running at a speed of 800 revolutions. Water for condensing is obtained from the River Maun, and is pumped by three electrically-driven pumps, each being calculated to deal with 20,000 gallons per hour. The water is fed into a large tank over part of the boiler house, from which it gravitates through the condensers, and is returned to the stream. With regards to the switch gear there are two separate boards. The dynamo board has six panels, and the feeder board seven. The whole of the switchboards and connecting cables have been erected and supplied by Messrs. Bertram Thomas, of Manchester. The battery consists of 292 L 17 K.W.S. type cells, manufactured by the Tudor Accumulator Co., Ltd., and is capable of maintaining a discharge of 100 amperes continually for 10 hours. The cells are placed on two-tier stands. The cables were supplied by the Western Electric Co., and are laid on the "solid" system. The total amount of cable laid up to the present is 13½ miles, including 4 miles of public lamp cables, supplying 30 arc lamps for street lighting. The lamps are of the Gilbert single-carbon type, and are erected on posts supplied by Messrs. Sansom Bros., of Mansfield. About 180 tons of refuse is collected in the town per week of six working days, and the object of the Corporation has been to thoroughly cremate without causing a nuisance, and in such a manner as to utilise the heat in raising steam for the electricity works. The destructor (supplied by Messrs. Heenan & Froude) has three cells with twin furnaces, with a burning capacity of 30 tons per 24 hours. Two water-tube boilers, each having 1,200 ft. of heating surface, are combined with the cells. Mr. Robert Hammond, M.I.E.E., has acted as consulting engineer to the Corporation, and Messrs. Vallance & Westwick, Mansfield, were the architects for the buildings. The contractors for the engine house plant were Messrs. T. Parker, Ltd., of Wolverhampton; for the condensing plant, Messrs. Johnson & Phillips, London; for the pipework and tanks, Messrs. Crompton & Co., London; for the meters, Messrs. Chamberlain & Hookham, Birmingham; and for the works wiring, the Mansfield Engineering Co. The buildings, with the exception of the chimney, which is 150 ft. high and is of special design by the Alphons Custodis Chimney Construction Co., were erected by Mr. John Greenwood, of Mansfield.

The ceremony connected with the formal opening of the works took place in the engine house. The Mayor (Councillor Crampton) was attended by all the members of the Town Council, the local public officials, &c., and the invited guests numbered several hundreds. At the outset Mr. Robert Hammond gave an interesting description of the works.

Other addresses were delivered by the Mayor (Mr. Crampton), the chairman of the Electricity Committee (Mr. Chadburn), the architect (Mr. Vallance), and the chairman of the Sanitary Committee (Alderman Patterson). The Mayor then started the engines, switched on the electric light, and declared the works formally open and the supply of electricity for light and power available in the borough. Subsequently the visitors were entertained to refreshments in a marquee adjoining the works, the contractors being the hosts.

In the evening, at the invitation of Mr. Chadburn, a large company sat down to a banquet in the Victoria Hall. Alderman Richmond (Hackney) proposed "Success to the Undertaking," and the Mayor of Chesterfield (Alderman Robinson) supported the toast, which was responded to by the chairman. Other toasts followed during the course of the evening.

Morecambe.—The report of the E.L. Committee for the past year shows that the net loss on the year's working was £1,531. Less electricity had been consumed as compared with the previous year, and the cost of generation had been reduced.

Northfleet.—The U.D.C. having applied for an extension of time in which to carry out the E.L. order, the B. of T. has informed it, that it will defer consideration of the question of revoking the order for one year from July 2nd. If on the expiration of that period definite steps have not been taken by the undertakers to carry out its obligations under the order, the Board will not be disposed to allow the order to remain any longer in force.

Penmaenmawr.—A deputation from the U.D.C. visited the electric lighting station at Colwyn Bay last week, and inspected the system of electric lighting on the Promenade, with a view to adopting the electric light at Penmaenmawr.

Pontypridd.—The District Council has decided to appoint a deputation to obtain an interview with the B. of T. and L.G.B., with a view to ascertaining its opinions as to how the powers of the Council already granted would be affected by a prospective three years' agreement with the power company for the supply of energy.

Saffron Walden.—The desirability of adopting an electric lighting system is down for discussion at the next Council meeting.

Scottish Central Electric Power Order.—There is every prospect of the promoters of the above order escaping opposition to their measure by granting the prospective clauses demanded by the burghs interested. The proposed arrangement is that the company agree not to compete with the Town Council inside the latter's area, while the Council undertakes to give facilities to the company for the laying of its cables through the burgh, subject to its approval as to route and the payment of wayleave.

South Staffordshire.—The directors of the South Staffordshire Mond Gas Co. have purchased an estate of about 17 acres adjoining the site of their central station at Dudley Port. The area of the land now owned by the company is nearly 40 acres, together with 54 acres of mines and minerals, and is bounded by the London and North-Western main line, the Birmingham Canal, and the main roads from Tipton to Wednesbury, and from Dudley Port to Princes End.

Southend-on-Sea.—The T.C. has been recommended, owing to the increased demand for energy, to expend £6,950 on extending the plant at the electricity works.

Spain.—A company has just been formed in Bilbao to put down a plant to utilise the waterfall known as the Lancha de Canes in Granada in the generation of electrical energy.

Stafford.—It was announced at the meeting of the Town Council last week that the electric lighting order empowering the Electric Light Committee to supply electricity outside the borough, has been granted. It was also stated that the opposition to the North-Western Electricity and Power Gas Bill has resulted in valuable clauses being conceded to the Corporation The Electric Light Committee. however, do not recommend that the application of the company for the Corporation to support the amended Bill in the House of Commons should be acceded to.

Teddington.—The U.D.C. has sealed an agreement for the leasing of the electric lighting order to the Twickenham and Teddington Electric Supply Co., which agrees to supply electricity within the compulsory area in three months' time. The Council is to have the option of purchase at the end of 7, 14 or 21 years.

Townhill.—The West of Fife Coal Co., Ltd., are arranging for installing electric plant at Townhill Colliery, so as to enable them to introduce coal-cutting machines and work the thinner seams. The Cairncubie and Swallowdrum seams range in thickness from about 2 ft. to 2½ ft., and both consist of hard, flinty coal, which it is almost impossible for men to produce in remunerative quantities.

Tynemouth. — The was no opposition at the L.G.B. inquiry into the application of the Corporation for £12,280 for electric lighting purposes. It is proposed to reduce the maximum price for electricity from 7d. to 5d., with a view to popularising the supply.

Watford.—The U.D.C. has decided to apply for a prov. order to enable the area of supply to be extended to the rural districts of Bushey and Watford. It is proposed to extend the generating plant by an additional 300 kw., and to undertake additional street lighting.

ELECTRIC TRACTION NOTES.

Blackpool.—At an extraordinary meeting of the shareholders of the Blackpool Electric Tramways (South), Ltd., held at Liverpool, Mr. M. Guthrie, who presided, stated that owing to the executors of Mr. Thos. Levins (? Nevins)—who had died since tendering for £70,000 for the reconstruction of the line—having declined to abide by the agreement, the company had been compelled to accept the next lowest tender of £74,000.

Last year the Corporation tramways made a gross profit of £15,994 and a net profit of £2,249.

Cardiff.—At the close of a discussion at the last meeting of the Tramways Committee regarding the rate of wages for the tramway employés on holidays, Mr. Arthur Ellis said he wished to make an explanation with reference to the estimate which he had made of the tramway receipts. If there were to be continued reductions in fares, it would be impossible for that estimate to come out correctly, in spite of the fact that the working expenses were about as low as any town in the country, viz., 4½d. per mile. The reduction of fares, the reduction of hours of labour, and increasing wages were serious matters, which the Committee should take into consideration whenever they compared his estimate with the actual results.

Copenhagen.—Captain Boyle reporting on the very complete and extensive system of tramways in Copenhagen, states that the service is worked by the overhead trolley; storage batteries have been entirely done away with, and horse traction is being gradually abolished. One can travel any distance from one to five or six miles for 1d., and transfer tickets enabling passengers to change cars are supplied free. The working expenses are about 7½d. per mile. The tramways belong to a company which has a 40 years' lease from 1899 from the municipality, and the municipality has the right to buy the various lines in 1908. The company has a capital of 16,000,000 kr. (£889,000), and employs 793 conductors and drivers, with about 127 hands in the various sheds, track cleaners, &c., besides day labourers. The motor-cars number about 184, and there are besides 75 trailers, 26 horse-cars, and 17 omnibuses. The length of the tracks, double line, is 33,550 kiloms.—1 kilom. = 1,094 yds.—and 11,700 kiloms., single lines, and the total length of the various routes where cars run by electric power is 45,810 kiloms. The length of routes where horse-power is used is 10,225 kiloms. In a very short time horse-power will be done away with and every car will be electric, besides the routes being much extended. The cars up to the present, Captain Boyle reports, have been built in Germany and in Denmark, also the electric plant, and he sees no reason why British firms should not compete for these supplies.

Darlington.—The specifications for the track had been prepared on a 3 ft. 6 in. gauge, measuring from the outside edge of each groove, but the lines of the Stockton and Middlesbrough system are laid on a 3 ft. 6 in. gauge, measuring from centre to centre of the groove. There is thus a difference of 1 in., which would prevent an interchange of traffic over the Darlington and other lines. The Darlington Tramways Committee met the other day to specially consider what to do, and a result of its deliberations was to continue with the gauge as in the specifications, thereby adopting a track different from that of the Middlesbrough system. The laying of the track was to commence on June 22nd.

District Railway.—The new electric trains between Harrow and Ealing did not commence running last Monday, as expected, owing to a landslip at Alperton. The service was opened the following day between Ealing and Park Royal for the Royal Agricultural Show.

Folkestone.—The T.C. has asked the B. of T. to extend the time in which to construct the electric tramways. The Council has decided that the conduit system would have no chance of pecuniary success in the town.

Glasgow.—At a meeting of the sub-committee of the Tramways Commitee on Monday a draft report on revenue and expenditure account for the year ending May 31st, 1903, was submitted by the general manager. The report is a highly satisfactory one, the net balance of the revenue over the expenditure being no less a sum than £100,276 18s. The details are:—Revenue for the year, £656,572 7s. 11d.; working expenses, £431,870 2s. 11d., made up of power, £20,112 10s. 5d.; traffic, £176,532 17s. 11d.; general, £44,014 8s. 5d.; repairs, £63,654 18s. 4d.; set aside to meet permanent way renewal, £53,516 13s. 3d.; annual depreciation written off, £74,038 14s. 7d. This leaves a balance of £224,702 5d., from which there falls to be deducted:—Payment to Govan Corporation, £5,053 2s. 8d.; interest on capital, £61,072 3s. 9d.; sinking fund, £43,294 0s. 7d.; payment to common good, £15,000; a total of £124,425 7s. This gives a net balance of £100,276 18s., which it is proposed to appropriate as follows:—Additional payment to common good, £10,000; additional depreciation, £65,000; general reserve fund, £25,276 18s. Last year's revenue amounted to £614,413 4s. 11d., an increase of £42,159 3s. The gross balance on that occasion, after deducting working expenses and writing off depreciation, was £209,310 4s. 4d., and the net balance £100,495 6s. 11d.

Gloucester.—Tenders for the installation, construction, and equipment of the new system of electric tramways at Gloucester under the Light Railways Order, in accordance with the specifications of the engineers, Messrs. Dickinson & Hammond, were opened last week, and despatched to the engineers for their consideration and report. A local journal understands that in all 110 tenders were received. Of these, 60 relate to the installation of new electrical plant at the Corporation Electricity Works, and 50 to the construction and equipment of the tramways. The engineers' report on the tenders will be submitted to a meeting of the Tramways Committee which will be convened in due course. The Committee had hoped to be in a position to recommend tenders for acceptance at this week's meeting of the City Council, but, owing to the large number of tenders dealing with various sections of the undertaking, and the mass of figures to be critically examined, the engineers have found it impossible to prepare their report in time. It is expected that the matter will be submitted to a special meeting of the Council to be held early in July.

Hamilton.—The inspection by the Board of Trade of the new electric tramline between Blantyre and Wishaw is expected to take place shortly. During last week the last connecting link in the rails of the entire system were completed, and during the early hours of the mornings trial runs were made with the cars over a large part of the route. These were satisfactory.

Huddersfield.—The Corporation Tramways Committee has approved of plans and estimates prepared by the borough engineer, Mr. K. F. Campbell, for proposed extension of the track to Whitestone Road and Hillhouse Coal Sidings (for electric haulage of coal), and the work will be proceeded with as soon as the railway companies have approved the plans. It has been resolved that the tender of Mr. Nuttall, of Manchester, be accepted for the execution of the work, and that the borough engineer obtain tenders for the materials required.

The Committee has granted an application from the British Electric Traction Co. for permission to copy the plans of the tramway system in Huddersfield.

The Committee has recommended the purchase of one four-wheeled and one eight-wheeled truck from the Brush Electrical Engineering Co., together with the equipments therefor, from the British Westinghouse Co., for the purpose of coal haulage.

The Mayor of Huddersfield, Ald. F. Culvert, who is chairman of of the Corporation Electricity Committee, will represent the Tramways Committee at the Municipal Electrical Convention to be held at Sunderland next month.

Some months ago negotiations were commenced with the view of the British Electric Traction Co. taking over from the Corporation the powers the latter possessed under Act of Parliament enabling them to extend the tramways without the borough to the Mirfield and Ravensthorpe boundaries. Certain provisional agreements had been come to in the way of protecting the rights of the Corporation, &c.; but in the Bill now being promoted in Parliament by the British Electric Traction Co., this portion of their scheme does not find a place.

In reply to Alderman W. H. Jessop, Councillor T. H. Moore (chairman of the Huddersfield Corporation Tramways Committee) last week said that the proposed extension had been struck out of the Traction Co.'s Bill because of various differences that had recently arisen between the parties in relation to the widening of two bridges and other matters. The final breach arose upon the question of affording protection to the Corporation's water mains against electrolysis. Councillor Moore said that the abandonment of the extension would be a great disappointment to the Mirfield U.D.C., who had acted in a most friendly manner towards the Corporation. He added that the Corporation was in no way to blame for the collapse of the scheme. The way in which "Much!

continually asked for "More," he stated, almost encouraged the belief that the company had altered their intentions, and were not anxious to proceed with their undertaking.

At a later stage Councillor Moore stated that all the Huddersfield cars had now been fitted with the Westinghouse magnetic brake, and an instance had occurred this week of its efficiency in saving life. A child fell across the track on the Fartown section, when the motorman was enabled to pull up the car in four yards. The life-guard touched the child, who, however, was unhurt with the exception of a slight bruise or two. The drivers of the cars all agreed, he said, that the brake was the most efficient of any that they had been called upon to operate.

Lanarkshire.—On the morning of the 19th inst., the contractors had a trial trip over a portion of the route of the Hamilton, Motherwell, and Wishaw Electric Tramway Co. The line was found to be in as satisfactory a condition as could be expected after the recent subsidences. As, however, the feeder cable dispute with Motherwell is not yet settled, it will be some time before the line can be opened for public traffic.

Lincoln.—Mr. John Young, manager of the Glasgow tramways, has been appointed arbitrator on behalf of the T.C. and Bracebridge U.D.C. in respect to the purchase of the tramway company's undertaking.

London.—The placard warning passengers not to stand up when an electric car is passing under Clapham Road Bridge has, as we expected, proved of little effect. The distance between the top of the cars and the bridge is quite inadequate. On the morning of the 17th a young man, not heeding the caution, was struck senseless on the roof of the car and received serious injuries. One newspaper says that hats are frequently knocked off at this spot.

Kensington.—The Borough Council on Tuesday resolved to support, by evidence, the Westminster City Council's petition to the House of Lords against the London County Council (Tramways and Improvements) Bill. A general opinion was expressed that the L.C.C. should not be subjected to less restrictions with regard to opening up the public streets than are imposed upon the various electric supply companies.

West Ham.—It was reported to the Council on Tuesday that sanction had been received from the Board of Trade to borrow £43,044 for the acquisition of the North Metropolitan Co.'s tramways. Arrangements were made to hasten the scheme for the electrification of the Barking Road line.

L. & N.-W. Ry.—It is reported that the London and North-Western Railway Carriage Works at Wolverton have now upwards of 4,000 men working only 3¾ days a week, owing to a scarcity of work, a thing which has been unknown for the past 16 years. It is proposed to run the Newport-Pagnall branch line by electricity as a trial to greater things.

Luton.—The Tramways Committee is to invite companies or private parties to submit schemes for an electric tramway system.

Mersey Railway.—The old locomotives and carriages of the Mersey Railway Co. are to be sold by auction to-day at Birkenhead.

Morecambe.—The T.C. has instructed the borough engineer to prepare a scheme for the electrification of the tramways.

Paris.—The omnibus company is becoming strangled by the competition with the Metropolitan Underground Electric Railway, and has set on foot a claim for compensation amounting to several millions of francs for interference with its monopoly. The company has recently come forward with a proposition to run its omnibuses by the overhead electric trolley system, and so very largely to reduce its working expenses. The men of art oppose this on æsthetic grounds.

Perth.—The preamble of the Corporation tramways provisional order to empower the T.C. on the acquisition by them of the tramways within and without the burgh to work and use the same, was proved on Saturday before a Commission which sat at Edinburgh. The Commissioner stated, however, that there might be a question of reducing the period for the sinking fund from 40 to 30 years, but that was a matter for Parliament. The order is expected to be formally ratified by Parliament on an early date.

Preston.—Another offer has been received by the T.C. for the leasing of the tramways, but the Corporation has declined to open negotiations.

Salford.—A loan of £3,931 is to be applied for by the T.C. for the electrical equipment of the Prestwich U.D.C.'s tramways in Bury Old Road.

Wolverhampton.—The members of the Corporation are at the present time in a sorry mess, and evidently they do not know their own mind. On Monday two meetings were held with reference to the present position of the Corporation as regards the Lorain Co. The first was a meeting of the Tramway Committee, held in the morning, and presided over by the chairman (Alderman Mander). This was followed by a meeting, in the afternoon, of the whole of the Council in Committee, that is, with closed doors, from which the representatives of the press were rigidly excluded. The object of both meetings was, as stated, (1) to consider the present legal position of the Corporation in respect to the arbitration proceedings for the final settlement of the points in dispute between the Wolverhampton Tramways Committee on the one hand and the Lorain Steel Co. on the other; (2) the opinion of eminent counsel on certain specific questions submitted by the town clerk for consideration in view of the approaching arbitration; and (3) to consider what steps should be taken to obtain from the Lorain Co. a further extension of time for the running of the trams beyond the limit of the last concession, which will expire on the 3rd prox. (Friday week). The Council meeting lasted for four hours, and it developed into a re-discussion of the tramway policy as between the supporters of the Lorain surface contact system on the one hand and those of overhead traction on the other, in the course of which some very strong views were expressed by the partisans on each side. The fact is, there have always been some waverers amongst those who voted on May 20th in favour of the Lorain system being discontinued and superseded by the overhead, and they now seem to have capitulated to the enemy. These waverers know the contract with the company is ambiguous, they know the costs of arbitration will amount to thousands, they know the result of the arbitration is doubtful, and they also know that members of the Corporation will be found in the witness-box against the Corporation. With these probabilities staring them in the face they appear to be content to "bear the ills they have, than fly to others that they know not of." The result is this, that a resolution, moved by Councillor Gough Allen, and seconded by Alderman Plant, was carried by 23 votes to 17, instructing the Tramways Committee to make a further appeal to the representatives of the Lorain Co. for a conference between them to see if some terms cannot be arranged by which the threatened arbitration proceedings, and consequent immense cost to the town in legal expenses, may be averted.

On interviewing a prominent member of the Town Council with respect to the inner meaning of this resolution, he stated "it practically means that we [the Corporation] are to commit ourselves to the adoption of the Lorain surface contact system, so far at least as it is at present laid down in the borough. As a matter of fact," he added, "ever since last Council meeting there has been a strong undercurrent at work with the object of inducing certain members of the Council, who on the previous occasion voted in favour of Councillor White's amendment for the substitution of the overhead in place of the Lorain system, to adopt a different attitude, by magnifying and exaggerating the difficulties in which the carrying out of that amendment would place the town. I regret very much that, as seen in the adverse vote recorded this afternoon, that policy has for the present been successful. But the decision was not arrived at without considerable difficulty. As a matter of fact, at the meeting of the Tramways Committee in the morning, Mr. Gough Allen's resolution for a further conference with the Lorain Co., with the view of coming to some terms, was defeated by six votes to four. Then he brought it on again at the meeting in full Council in committee in the afternoon, and this led to a re-opening of the whole question of tramway policy, and at times, I may tell you, the debate became very warm. It was seen very early in the discussion that we had to contend against a good many Wolverhampton wobblers, men who have wobbled in the Council on previous occasions." Another meeting of the Council is to be held on an early date for the purpose of confirming the above resolution. This will be open to the Press, but according to present arrangements there are to be no speeches on the subject, which it is held has been thoroughly threshed out by the Council in committee. The whole proceedings are to partake of the nature of a dumb show. "The chairman of the Tramways Committee, or perhaps the Mayor," said the member of the Council interviewed, "will get up and move the adoption of this foregone conclusion; someone else will second it; then the resolution will be put to the vote; no discussion will be allowed; and by means of the mechanical majority which the committee has got, including those 'wobblers' that have been recently captured, the whole thing will be carried through. In other words, the ratepayers outside, whose property is being dealt with, are to be kept in the dark until the whole thing has been settled. Then they will be called upon as usual to pay the piper."

TELEGRAPH AND TELEPHONE NOTES.

Post Office Trunk Calls.—Mr. Brotherton asked the Postmaster-General if he could see his way to increase the time limit for trunk calls upon the telephone system of the Post Office from three to five minutes, and, in reply, Mr. Austen Chamberlain says:—Owing to the time required to obtain the connection of subscribers' exchange lines with the trunk lines, not more than about 12 conversations an hour are possible under the best conditions on any trunk line with the three minutes' limit. An increase in this limit would make the lines available for fewer subscribers and would involve a proportionate increase in the charges for their use. As about 95 per cent. of the present trunk line conversations are completed within three minutes, and as the traffic is practically confined to business hours, a general extension such as is suggested would clearly not be to the advantage of the public. An extension of the limit between 8 p.m. and 6 a.m. from three to six minutes was made in March to encourage the use of the trunk lines at hours when hitherto they have been little used.

Telegraph Cable Imports.—The value of the imports of foreign telegraph cables and apparatus connected therewith, imported into this country during May last was much below the average, being only £979, bringing the total for the first five months of the year up to £26,618.

(*Continued on page* 1096.)

THE NEW ELECTRICITY WORKS OF THE MANCHESTER CORPORATION.

THE LARGEST ELECTRIC POWER DISTRIBUTION UNDERTAKING IN GREAT BRITAIN.

We have so frequently referred to the electricity supply undertaking of the Corporation of Manchester, and to the progress of the electricity works, that we need not devote much space to introductory remarks before commencing a detailed description of the new works. In our issue of May 30th last year, in connection with the formal inauguration of the Stuart Street station, we briefly outlined the schemes which the Corporation then had in hand. These included the installation at Stuart Street of generating plant having a capacity of 9,000-KW., to Dr. A. B. W. Kennedy's specifications, and 10 sub-stations, costing in all £492,000; and the erection of an additional station at Stuart Street alongside of the first one, to be equipped with plant of 7,500 KW. capacity to the specifications of Mr. G. F. Metzger, city electrical engineer, as well as 19 sub-stations, the latter scheme costing about £450,000, including the mains in each case and a cable subway. In addition to these large installations, the Corporation had already completed the new works at Bloom Street, separated from the original works at Dickinson Street only by an arm of a canal, and having a normal output of 7,200 KW. Adding to the outputs given above that of the Dickinson Street Works, which has been raised by additions and substitutions of plant to 10,350 KW., the total output of the three works existing at this moment is no less than 26,550 KW., so that already the undertaking considerably exceeds in point of generating capacity any other in the United Kingdom. When the sets now under construction are completed, bringing the total capacity up to more than 34,000 KW., the excess will amount to about 40 per cent. more than the undertaking next in magnitude, of the same nature, viz., electric lighting, power and traction supply. The Glasgow works, with about 24,000 KW., appear to be the second in size in this country. Besides the article referred to above, we may also mention those on pp. 955-6, December 5th, 1902, and pp. 391-2, March 6th, 1903, as containing many interesting particulars relating to these works.

Plan of Area Supplied.

The load is at present divided as follows:—About 400,000 lamps are connected to the mains, while over 1,000 motors, of about 4,000 H.P., and tramways comprising about 130 miles of single track, with 400 motor-cars, are supplied from the Corporation stations.

One of the most remarkable features of the undertaking consists in the number of local authorities beyond the city boundaries who derive their supply of electricity from Manchester, both for light and power and for traction; the Corporation, in fact, has control of the largest and most important "electric power distribution" undertaking, in the wider sense of the term, that exists at present in Great Britain.

The system of supply from Stuart Street station, which we shall deal with first, is the three-phase alternating current system, energy being generated at 6,500 volts, with a frequency of 50 cycles per second, and transmitted to sub-stations through underground cables. At the sub-stations the energy is converted by means of motor-generators to direct current, at 500—550 volts for traction, 205 and 410 volts for light and power supply. As will be seen in the outline plan below, the site is on the north-east of the city, not very far from the centre of the area supplied.

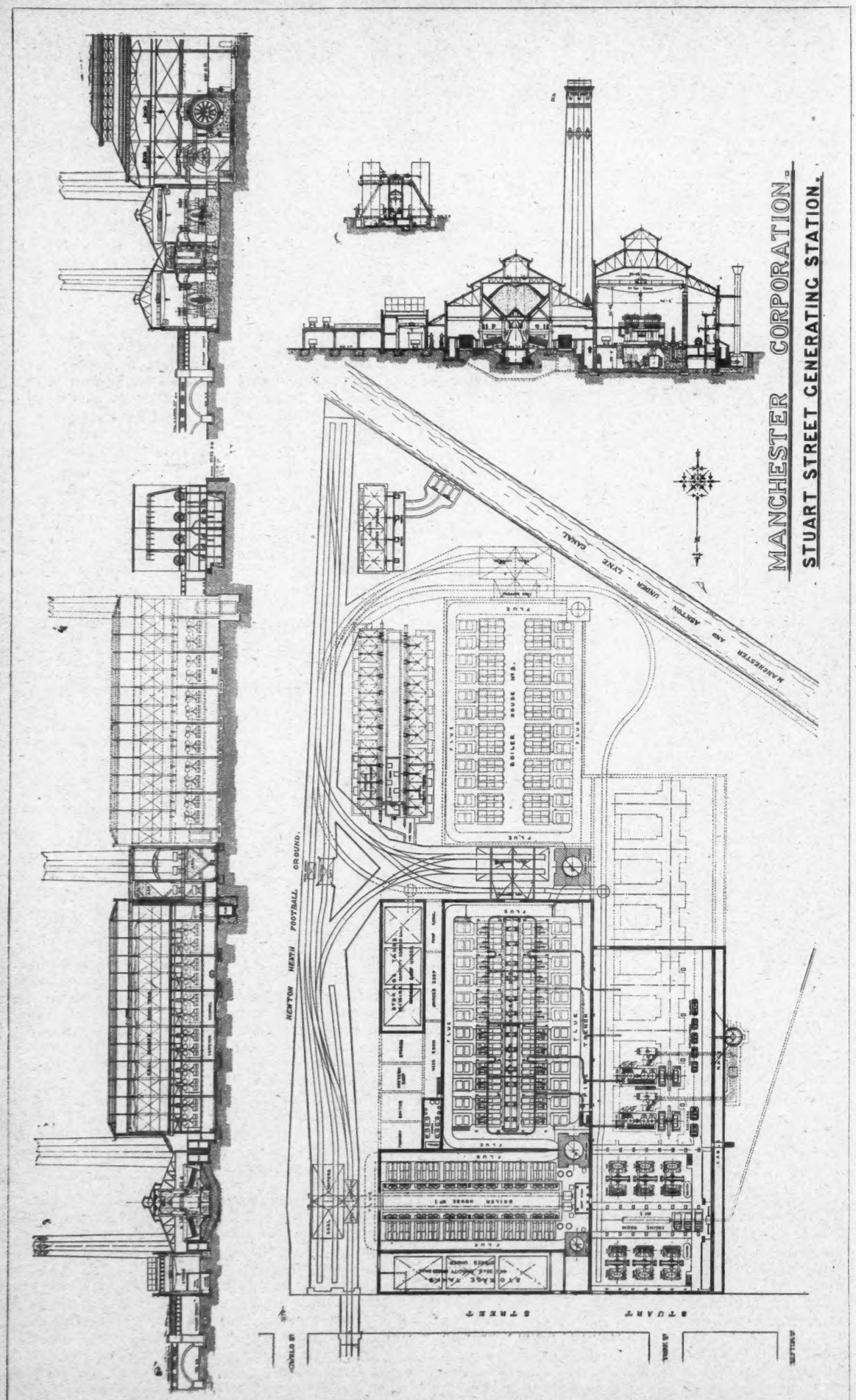
The enormous scope of the complete scheme which has been prepared by Mr. G. F. Metzger, in addition to the plant which has already been laid down to Dr. Kennedy's designs, may be gathered from the plan of the site which we give on the next page. The plant at present installed consists of 24 boilers and six steam alternators, together with the necessary auxiliary plant.

Coal is brought to the station in carts for the time being, but a viaduct over half a mile in length is approaching completion, by means of which it will be made possible for trains of coal trucks to be brought from the L. and Y. Railway right up to the works. The coal will be tipped from the trucks into hoppers, whence it will be carried by two bucket chain conveyors of the New Conveyor Co.'s make, driven by electro-motors, into the bunkers over the boiler house. The same conveyors will remove the ashes from beneath the stoking floor to trucks or barges. At present the conveyors are not in use, the coal being lifted from a hopper at the end of the boiler house by a Priestman grab, and elevated by a crane direct to the top of the building, where it is delivered to the bunkers by Decauville trolleys, each holding 1 cb. yd. Ample provision is made for weighing the coal, and the shoots from the bunkers are fitted with measuring boxes holding 5 cwt. each.

The condensing plant is not, as yet, in use, the cooling towers and connections being incomplete. The Manchester and Ashton-under-Lyne Canal bounds one side of the site, and will supply the make-up water for condensing, but a large installation of cooling towers is in course of erection to dissipate the heat carried off in the condensing water.

The buildings, which were designed by Messrs. Allott and Son, consist of a steel framework filled in with brick, the walls being faced with white glazed brick with a brown dado. The roofs are fitted with large skylights and ventilation lanterns, and the interior of the buildings is also well-lighted by side windows. The engine room is 114½ ft. long × 131 ft. wide, and 40 ft. high to the rails of the travelling cranes. The boiler house is 200 ft. long and 94 ft. wide. The boilers are arranged in two rows, with a space between them 23 ft. wide, over which is the coal bunker; the latter is capable of holding about 1,000 tons.

The boilers are 24 in number, of the Babcock & Wilcox type, each capable of evaporating 12,000 lbs. of water per hour at a pressure of 200 lbs. per sq. in., but working normally at 170 lbs. Each boiler has a heating surface of 3,580 sq. ft., and consists of 160 4-in. tubes expanded into staggered headers, which are connected at the ends with two steam and water drums, 42 in. in diameter, joined at the rear end by a steel cross-drum 20 in. in diameter. The mechanical stokers are of the chain-grate type, with a fire-brick arch over the fire to facilitate complete combustion of the gases; the stokers are driven by four Bruce Peebles motors, coupled to shafting in four sections,


MANCHESTER CORPORATION.
STUART STREET GENERATING STATION.
MANCHESTER SHIP CANAL.
NEWTON HEATH FOOTBALL GROUND.
BOILER HOUSE No.
FLUE
STUART STREET

each motor being capable of driving two sections. There are no economisers; there is a cross flue at the end of the boiler house remote from the chimneys, uniting the two longitudinal flues, so that either of the chimneys can be used alone. There are at present two chimneys, one 200 ft. high and 13 ft. in diameter, the other 250 ft. high and 18 ft. in diameter, both lined with firebrick to a height of 100 ft. The larger chimney is intended to carry the waste gases from the extension boilers, as well as from those already installed. A cast-iron exhaust pipe runs up the centre of each chimney—3 ft. in diameter in the case of the smaller chimney, 4 ft. in the larger.

The main steam pipes are in duplicate in the boiler house, and in the form of a ring in the engine room. The former increase from 12 in. to 20 in. in diameter where they enter two large vertical headers, and they are joined by a 16-in. bend at the middle of their length; each boiler is connected

View in Boiler House, Stuart Street Electricity Works: Babcock & Wilcox Boilers.

with both pipes by separate branches. The piping, which was carried out by the Sir Hiram Maxim Electrical and Engineering Co., Ltd., is of lap-welded steel with wrought-iron flanges, and is slung from the cross girders; it is covered with magnesia sectional covering. The valves are of Messrs. Hopkinson's make.

The two vertical headers mentioned above are 24 in. in diameter, and 9 ft. high; from each of these four headers 10-in. pipes are taken in a double bend, as shown in one of our views on p. 1090, to two receivers close to the engine room wall, each 30 in. in diameter, and 15 ft. high, which also act as separators. The bends referred to provide for the expansion of the long lengths of main piping. From the separators two 15-in. steam pipes pass into the engine room, where they run round the centre bay, and are joined together at both ends through stop valves, forming a complete ring.

The space between the chimneys is used for the feed pumps and heaters. There are three feed pumps, of Messrs. G. and J. Weir's compound duplex type, each capable of delivering 15,000 gallons per hour; the pumps are built so that either side can be used alone, and they draw either from the town water mains, from a feed-water tank overhead (which is divided into two sections), from the condenser discharge pipe, or from the main drain tank, with duplicate steam and water piping. The heaters are four in number, of the Berryman type; they are the largest size made by Messrs. Joseph Wright & Co., and each is capable of heating 50,000 lbs. of water, 150° F. per hour, with an equal weight of steam. The auxiliary plant is always run non-condensing, and the exhaust steam is passed through these heaters, one of which appears in the view referred to above. The feed-water tank has a capacity of 25,000 gallons; a larger tank, to hold 500,000 gallons, is to be built over the workshops.

The engine room, which is shown in the left-hand corner of the plan on the opposite page, is arranged in three bays, the two outer ones containing the main generators, and the middle one the condensing and auxiliary plant. Two 20-ton cranes, of 49 ft. 6 in. span, are provided in the north bay, and a similar one in the south bay; these are electrically-driven, and were built by Messrs. Higginbottom & Mannock, Ltd. A crane of the same capacity and make traverses part of the centre bay over the auxiliary engines.

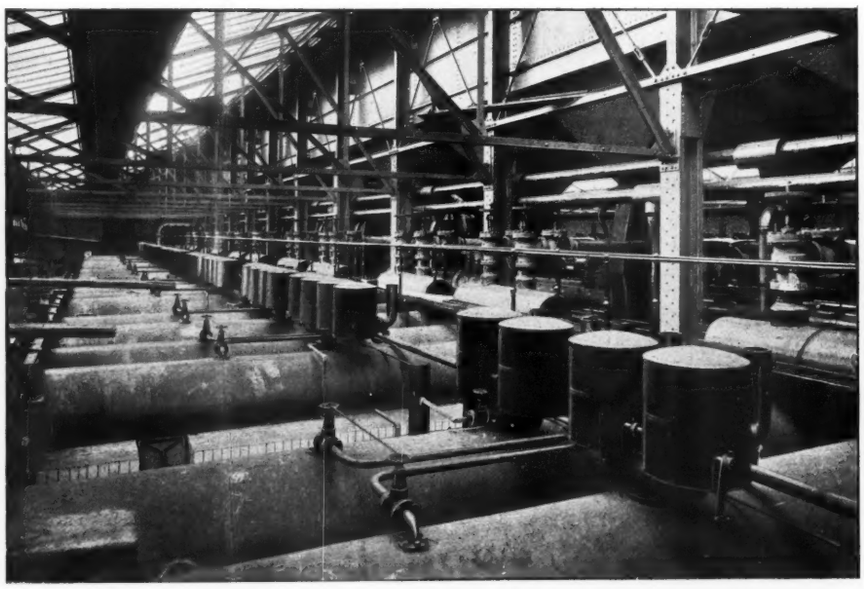
There are six main generating sets, each consisting of a 2,500 I.H.P. vertical cross-compound engine, built by Messrs. Yates & Thom, of Blackburn, and driving direct a polyphase generator supplied by the Electrical Co., Ltd., of 1,500 KW. capacity, at 94 revolutions per minute. Each engine is connected by a single branch with the ring steam main, and galleries round the cylinders provide access to all of them, and to the main switchboards, which run along the west end of the room.

The cylinders of the engines are 36 in. and 71 in. in diameter respectively, and the stroke is 3 ft. 6 in. The normal load of the engine is 2,500 I.H.P., with a steam pressure on the stop valve of 160 lbs. per square inch.

The cylinders are of the built-up type, with separate ends and barrel, the valves, which are of the Corliss double-ported type, being placed in the cylinder ends; by this arrangement one-half of the cylinder end forms a steam box. The barrels are also steam jacketed, in the case of the high-

pressure cylinder with boiler-pressure steam, and the low-pressure cylinder with steam at about 70 lbs. pressure.

The steam valves are worked by Messrs. Yates & Thom's trip gear, the closing of the valve being accomplished by



View Over Top of Boilers.

powerful vacuum dashpots. The exhaust valves have a plain vibrating motion, derived, like the motion for the steam inlet valves, from eccentrics fixed on the crankshaft.

Special attention has been given to the question of governing, and a very powerful and sensitive governor is supplied to the engine, having various special devices attached to it for dealing with widely varying loads, and acting on both cylinders. It is fitted with a special safety arrangement which will completely stop the engine in the event of its reaching a speed 10 per cent. above the ordinary working speed, and will also stop the engine in the event of any failure of the governing gear whilst it does not interfere with the engine taking excessive overloads, even beyond the full range of the cut-off gear. The governor is controlled from the main switchboard by an electrical device, to which we shall return later. Each cylinder rests on two massive cast-iron standards, with bored guides for the main piston rod crosshead. The vertical standards are coupled across by two cast-iron entablature beams, which, besides serving to tie the high and low pressure engines together, carry also the upper platform.

The engines are very solidly constructed, and of massive proportions; as evidence of this, the following weights of various parts may be mentioned: — Bed frames, each about 19½ tons; vertical standards, each about 8 tons; crankshaft, about 16½ tons.

The pistons are of cast-iron, fitted with Ramsbottom rings, and having also bands of white metal to increase their wearing qualities.

The piston rods, crossheads, connecting rods, and crankshaft are of mild steel forged from Siemens-Martin open-hearth acid-process ingots; the rod is secured to the piston by means of a large nut, and cottered into the crosshead in the usual way. The crosshead is fitted with gun-metal steps, held in place by a mild steel cap secured by two bolts.

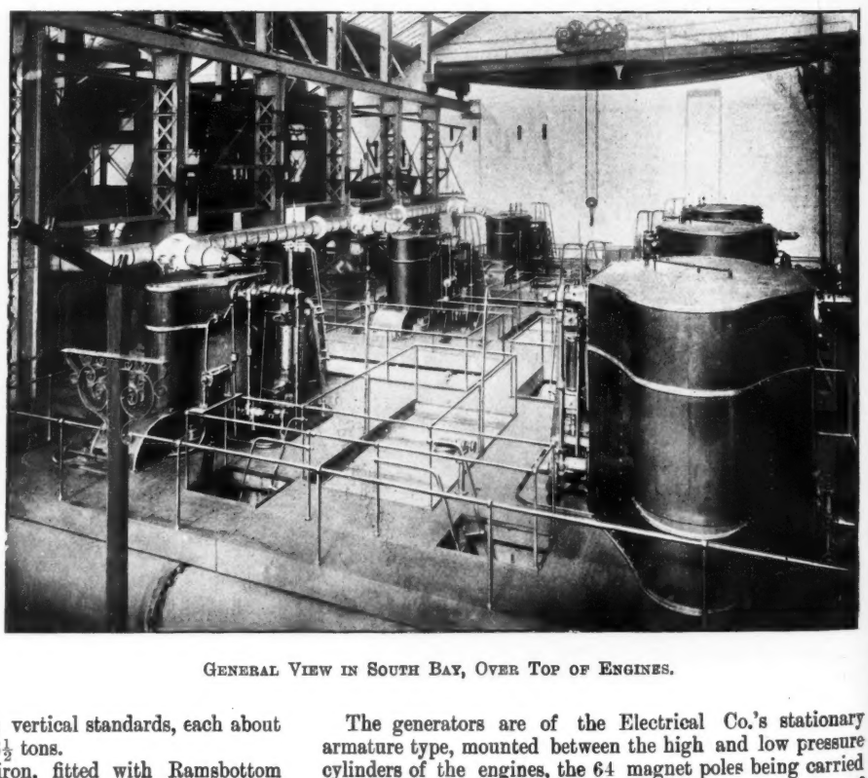
The connecting rod ends at the top in a jaw, having a pin shrunk in to suit the crosshead; the bottom end is of the marine type, with a palm end forged on the rod and a mild steel cap. The steps of cast-iron, lined with Babbitt's metal, are secured between the palm end and the cap by means of strong bolts. The crank pin is 14 in. in diameter.

The crankshaft main bearings, 25 in. in diameter, are of cast-iron, lined with Babbitt's metal, and fitted with a special arrangement of oil pipes giving ample lubrication.

The fly-wheels measure 15 ft. 3⅞ in. in diameter, and weigh about 70 tons each; the periphery is turned and drilled to receive the alternator pole-pieces. Each wheel is built up of four sections.

A very complete system of lubrication has been supplied to these engines, consisting of two ram pumps worked by drag shafts from the main cranks, and delivering oil to all the main bearings about the engines, as well as to the eccentrics; all the various parts of the engine are protected by oil throwers and covers so as to prevent the splashing of oil.

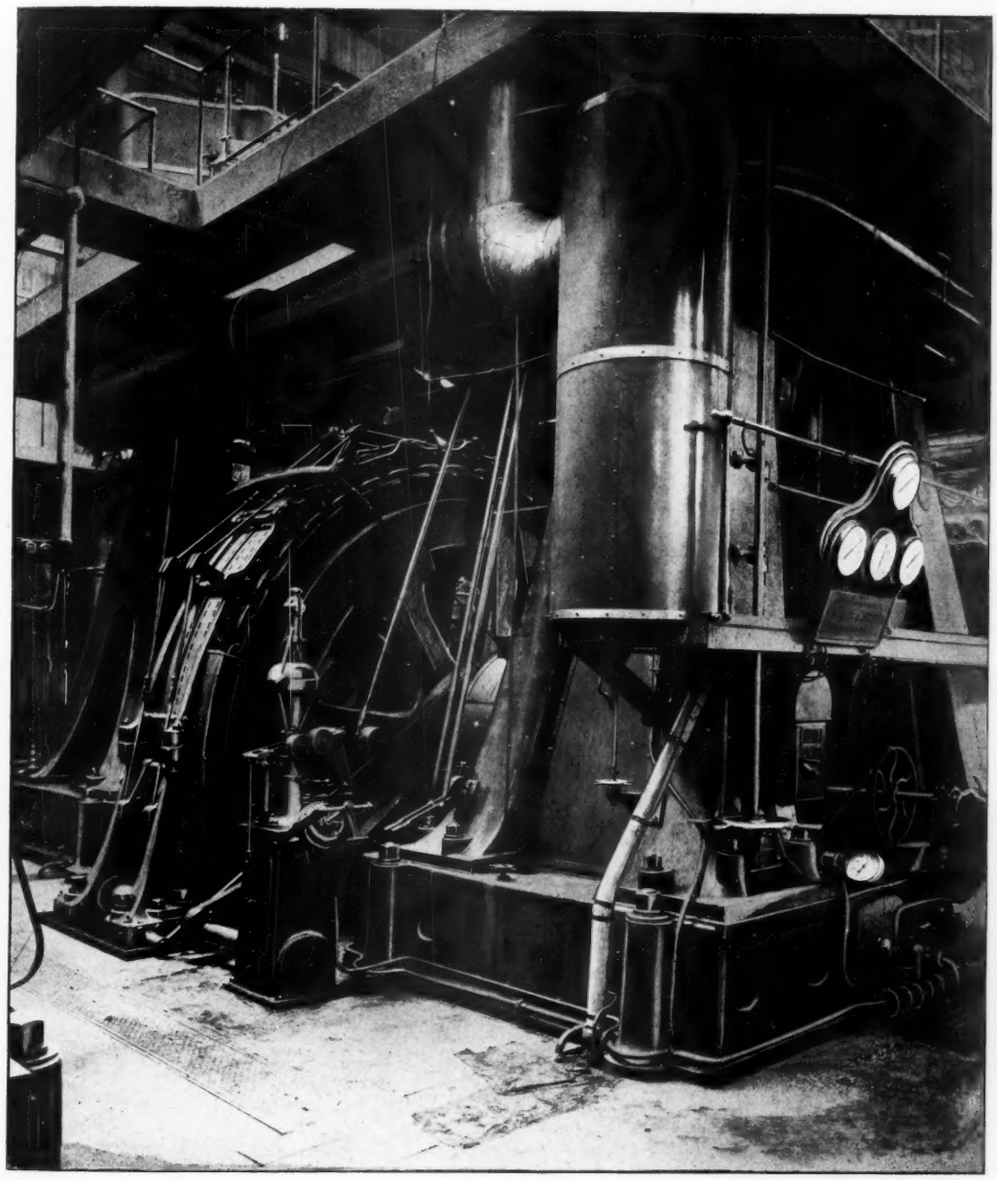
The barring gear is driven by an electromotor of 10 H.P., through spur wheels and worm gear.



General View in South Bay, Over Top of Engines.

The generators are of the Electrical Co.'s stationary armature type, mounted between the high and low pressure cylinders of the engines, the 64 magnet poles being carried on the periphery of the fly-wheel. Two large slip rings, of gun-metal, each provided with four brushes, serve to convey

the exciting current into the field magnet winding. The armature is of the Electrical Co.'s tie-rod construction, the usual massive frame being replaced by cast-iron cheeks clamping the core laminations together; the structure is strengthened by means of nine tension rods round the circumference, the topmost rod being horizontal and the two lowest rods meeting at a point vertically beneath the shaft. There are also two diagonal stay rods on either side of the frame, crossing over the shaft from the upper part of the frame to the pedestals which carry the weight of the armature. The frame is divided in the horizontal plane. The winding is disposed in the usual way, in two holes per pole per phase.



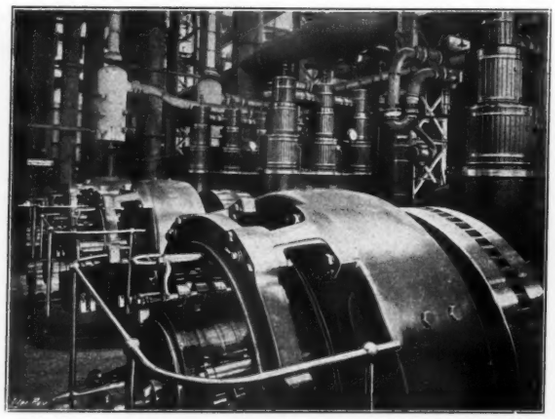
1,500-kw. Generating Set. Yates & Thom Engine; Electrical Co.'s Alternator.

Each engine is provided with a separate set of condensing plant, which is constructed on the barometric principle, and was supplied by Messrs. Willans & Robinson. The appearance of the condensing plant, which is situated in the central bay, is shown in two of our views on the next page. Each condenser chamber, shaped like a funnel, is elevated upon a stand pipe, which ends in a tank below the floor level, the total height from the bottom of the tank to the top of the water supply pipe being 34 ft. The condensing water is delivered tangentially into the condenser chamber, whirls round the conical base of the latter, and falls down the stand pipe, entraining with it not only the condensed steam, but also the air, and carrying them away to the tank below. The latter is provided with a stand pipe extending upwards through the roof, to carry off the air liberated from the water. The injection water is supplied to the condenser by a Gwynne centrifugal pump with a 13-in. delivery, driven at 800 r.p.m. by a motor of the Electrical Co.'s make; no other pump is required, and, owing to the natural lift due to the vacuum, even this one is only required to lift the water a few feet, except at starting. Less water is required for condensing than with either jet or surface condensers of the ordinary type, and the pumping plant need only be of small size and power, while the floor space occupied is extremely small. The condensing plant provided for each engine is capable of dealing with the condensed steam when the engine is working at 20 per cent. overload, or about 50,000 lbs. of steam per hour. The hot water flows away along underground pipes to the cooling towers, or to the canal.

An alternative exhaust is provided to the atmosphere by a 36-in. cast-iron main under the engine room floor, connecting with the two exhaust pipes which run up the chimneys.

At the west end of the central bay there are three auxiliary generating sets, each consisting of a Willans 3-crank compound engine, with cylinders 12 in. and 20 in. in diameter,

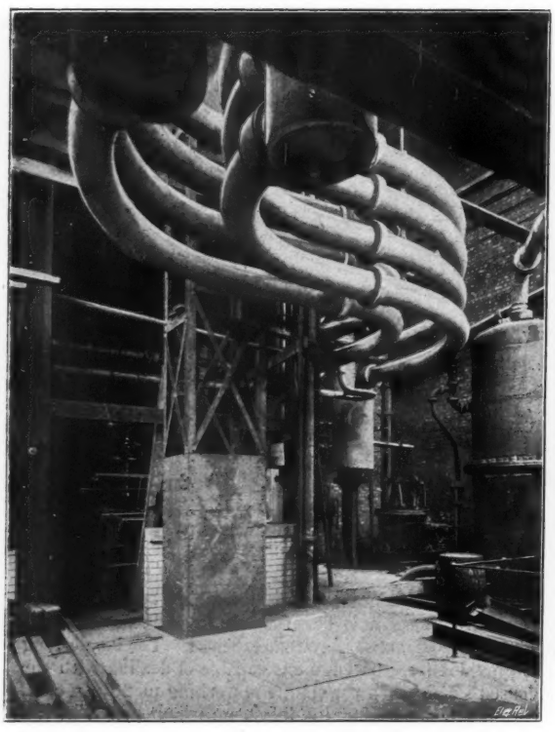
stroke 9 in., running at 350 r.p.m., and coupled direct to a 200 KW. shunt wound dynamo of the Electrical Co.'s make, generating current at 220 volts. These sets are used for supplying power for lighting the station, and for driving the various motors working the pumps, barring gear, stokers,



Auxiliary Generating Sets.

&c. They can also be used for exciting the main generators. These three sets are provided with duplicate steam pipes, connected to the ring main at points on either side of a stop-valve at the middle of the latter,

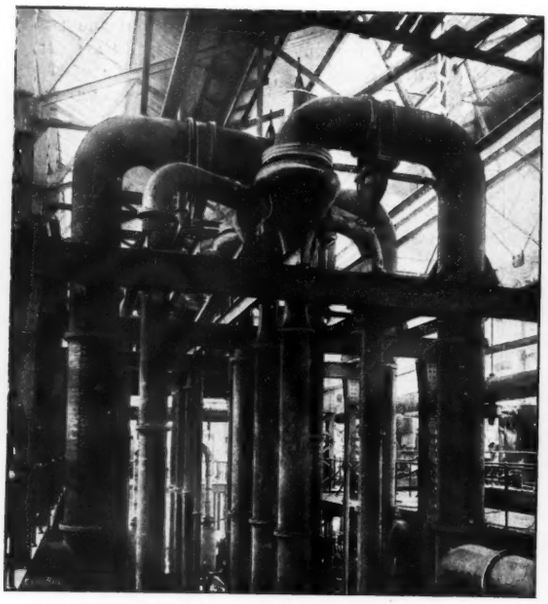
The three-phase generators are normally excited by two motor-generators, each consisting of a three-phase induction motor fed from the 6,500-volt bus-bars, direct coupled to a shunt wound six-pole dynamo, generating at 220 volts. Each of these sets is capable of providing exciting current for three of the main generators, and is rated at 90 KW. The set is provided with three bearings, and the rotor of the motor



Expansion Bends, Feedwater Heater, Etc

is fitted with a neat device to prevent the brushes from being lifted before the rotor is short-circuited when the machine has been run up to speed.

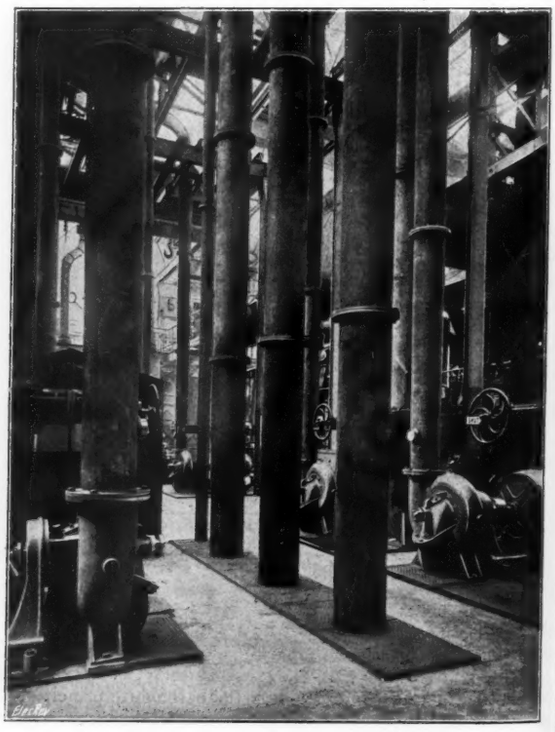
The remaining running machinery consists of two mains-chargers, each comprising a direct current motor coupled to a comparatively large three-phase generator—the latter having to be large in order to carry the capacity current when charging the feeders. There is also a portable motor air-compressor for cleaning the machinery.



Upper Part of Barometric Condensers.

We turn now to the switchboards, which form a prominent and important feature of the station.

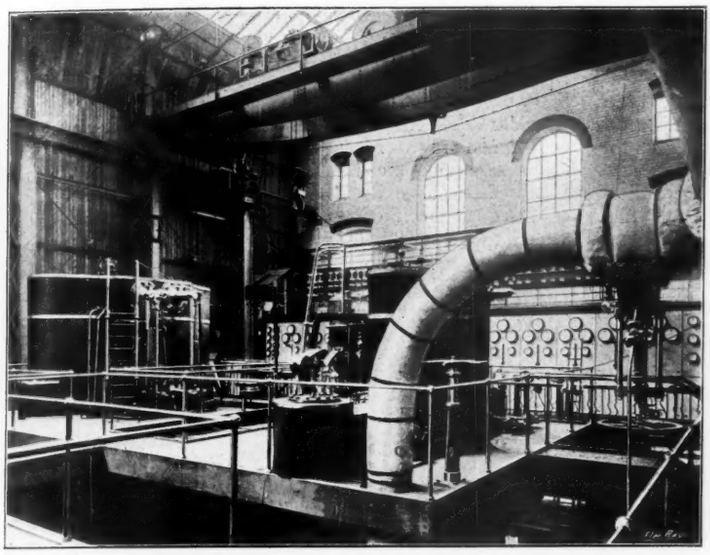
The switchgear formed part of the Electrical Company's contract. It comprises two main boards, each opposite to and controlling three of the main generators, as well as one



Lower Part of Barometric Condensers.

of the exciter sets, and seven high-pressure feeders; two boards for the exciting current, on a level with and between the main boards; and a light and power board beneath the exciter boards. The switchgear is really arranged in four tiers; the lowest tier is beneath the floor level, and contains the sealing and dividing boxes for the main cables, the

spark gaps for the feeders, and the field regulating rheostats of the main generators. The second tier is raised above the floor, and contains the fuses in circuit with the feeders and generators. The third tier is the switchboard proper,



View Towards South-West of Engine Room.

and is mounted on the switchboard gallery, which is connected on the same level with the galleries round the engines and round the engine room. Above this is a gallery carrying selector switches, whereby any generator or feeder can be connected with one or other of two sets of bus-bars. Normally it is intended to use one of the main boards for supplying power to the feeders connected with the traction motor-generators in the sub-stations, and the other for supplying power to the lighting motor-generators; but by means of the above-mentioned selector switches and bus-bars, either board and any of the generators may be used for either purpose.

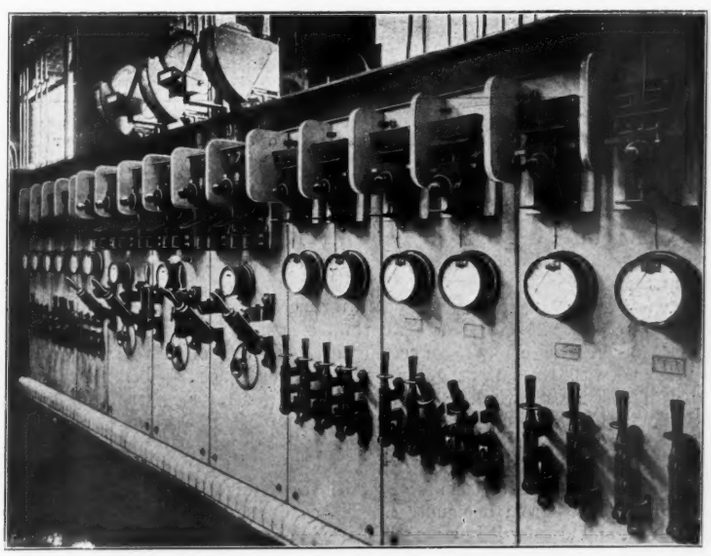
The fuses referred to above, in the second tier (beneath the switchboard platform) are of considerable interest; in the case of the feeders, they are arranged in wheeled carriages, which run on rails and can be bodily drawn back and isolated from all the live contacts, to enable the attendants to replace fuses in perfect safety.

The main generators and the induction motors of the exciter sets are provided with duplex fuses in hinged frames, so devised that a spare set can be inserted in parallel with the working fuses before taking the latter out of circuit; the operation simply consists in raising one hinged frame carrying three fuses, pushing it into place, and lowering a corresponding frame similarly equipped. Thus at any time the fuses may be exchanged or examined, without danger to the person or risk of interrupting the circuit. The fuses are enclosed in earthenware tubes.

The main switchboards consist of white marble panels carried in iron frames, the back of the boards being arranged on the open-framework principle characteristic of Continental practice. In front of each board is a wide platform, which commands a clear view of the corresponding engines; communication with these is provided by mechanical telegraphs such as are used in ships' engine rooms. The regulator hand-wheels for the rheostats controlling the excitation of the generators are mounted on standards at the edge of the platform, and the ammeters in circuit with the field windings are fixed on the tops of the standards above the hand-wheels, forming an extremely neat and convenient combination. The speed of the engines is controlled from this position by an ingenious electrical device, consisting in effect of a small controller on the switchboard platform, and a small motor mounted on a lever in connection with the governor of each engine—the latter clearly shown in our view of one of the generating sets on p. 1089. The motor is worked by direct current, and is so arranged that it reproduces exactly the motions of the hand-wheel on the platform, thus screwing itself in or out on the lever arm, and varying the effective weight on the governor spindle. Another noteworthy device is a telephone and battery circuit, used for the purpose of synchronising the engines, not only electrically, but also mechanically. The circuit is carried to the valve gear of each engine, which momentarily closes it at a certain point in each revolution of the crankshaft. The make-and-break is short-circuited in the case of an engine which is at rest. It will be seen that unless the contacts are made simultaneously on each engine which is running, the telephone circuit will never be complete; hence it is only when the engines are running not only at the same speed, but with their cranks in step, that the telephone responds.

Each of the main switchboards comprises 15 panels. Starting from the centre bay, there is a phase indicator and two voltmeters, reading 3,000 — 7,000, for synchronising purposes. The former shows 6,500 volts when only one machine is excited; but when a second machine is excited in readiness for paralleling, and is in phase, the reading rises to 13,000. This has the advantage over the ordinary zero method, that an apparently correct phase cannot possibly be indicated through a failure of any part of the apparatus. The synchronising gear can be used to parallel any of the machines, and also for paralleling the bus-bars on either or both boards.

Recording ammeters are provided for the purpose of recording the traction load, which is charged for on the maximum demand system.



Switchboard for Auxiliary Generators, Works Motors, &c.

The first panel carries three voltmeters for each set of bus-bars, six in all, and a wattmeter on each set. The next controls one of two sets of cross-connector cables between the two boards, and carries three ammeters, a main switch

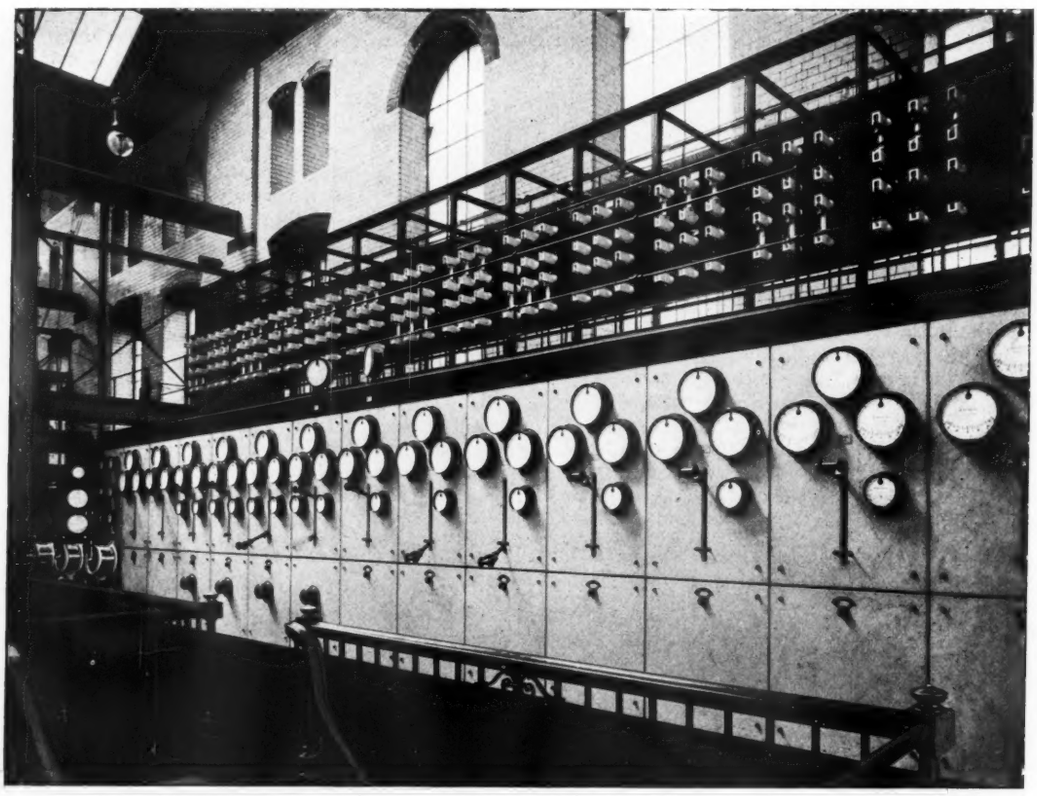
and synchronising gear; the third panel controls the coupling between the two sets of bus-bars on the same board, and is similar to the second. The fourth to the sixth panels each control one of the main generators, bearing three ammeters, one wattmeter, one phase meter, synchroniser and watt-hour meter. The seventh panel is for one of the exciter sets, and is similarly equipped. Next come seven panels devoted to the control of feeders, each carrying three ammeters, a phase meter and a synchroniser. The fifteenth panel is used for the feeder charging gear, and is fitted with three voltmeters reading to 7,000 volts, three ammeters reading to 6 amperes, one voltmeter reading to 250 volts, and an ammeter with central zero, reading up to 70 amperes either way. The same panel also bears the main switches and regulators for the motor and generator of the charging set, motor starter and synchroniser. At the end of the board there is a phase indicator reading to 13,000 volts, and above the middle of the board are two main voltmeters for the top and bottom sets of bus-bars. A steam pressure indicating and recording gauge is fixed near the board.

There is a gallery over the main board for access to the selector switches, which consist of two rows of panels one above the other, with contacts connected with both sets of bus-bars and with the various generator and feeder panels, so that, by means of switch plugs, any feeder or generator can be coupled to either set of bus-bars.

The back of the main board is inaccessible without authority, and all the gear is guarded with metal screens from accidental contact. Three colours are used to distinguish the various phases from one another. The conductors are mostly bare, and are carried on porcelain insulators fixed to the framework. Rubber mats are provided all over the floors near the boards.

The exciter boards are provided with switchgear to control the motor-generators used for excitation, and with means for paralleling with the auxiliary sets and exciting from them. The switchboard for the auxiliaries consists of nine marble panels, most of which are equipped with circuit breakers, main switches, and ammeters for the generators, crane motors, barring motors, works and subway lighting, works motors, motors of charging sets, &c. Over the board are two voltmeters reading to 225 volts, and three ammeters reading to 1,400 amperes. Some of the instruments on this board are of Messrs. Evershed & Vignoles' make; the board was supplied by the Electrical Co.

The main feeder cables are led away through a subway, which is 10 ft. high, 5 ft. wide, and extends for a distance of 940 yds., passing under the canal, and ending at Ashton New Road. There is room in the subway for 50 or 60 heavy cables, about half of which are in position, in racks on either side. All the cables were made by Messrs. W. T. Glover, and are paper insulated and lead covered. All the three-phase cables are armoured with iron wires in addition. Pilot and telephone cables have been provided, and a number of direct current traction cables have been laid, but will not come into use until further progress has been made with the extensions at Stuart Street. Beyond the subway the cables are laid on the solid system.



Main Switchboard, North Bay, Stuart Street Electricity Works.

The subway is electrically lighted throughout, well drained and ventilated; it was constructed to the designs and under the supervision of Mr. Meade, the city surveyor.

The erection of the first installation of cooling towers is being carried out by the Klein Engineering Co., Ltd.; there are four towers, provided with electrically-driven fans for circulating the air, and centrifugal pumps to raise the water to the distributing troughs. These towers are situated at one end of the site, close to the canal.

A testing tank is to be erected over the feed-water storage tank, capable of dealing with a load of 4,000 kw.; the arrangement is to be such that a large proportion of the heat given off will be imparted to the feed water, and thus reclaimed. The immersion of the electrodes will be controlled from the switchboard platform.

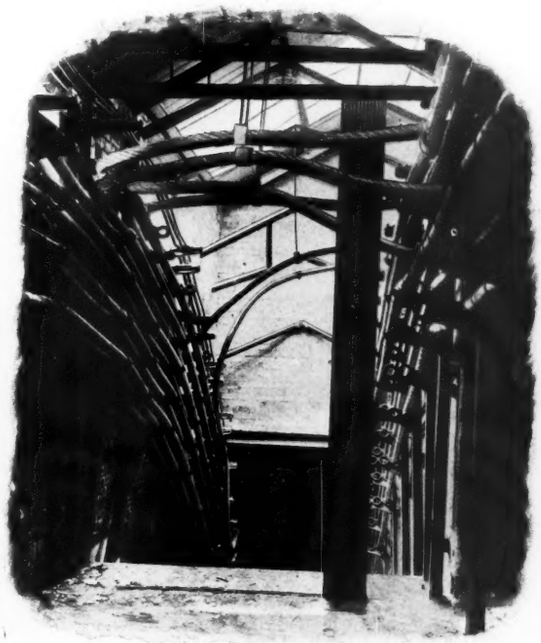
An account of the extensions which have been designed by the City electrical engineer, Mr. G. F. Metzger, and the description of the sub-stations, Bloom Street works, &c., must be deferred to a later issue.

(To be concluded.)

THE POPLAR ELECTRICITY WORKS.

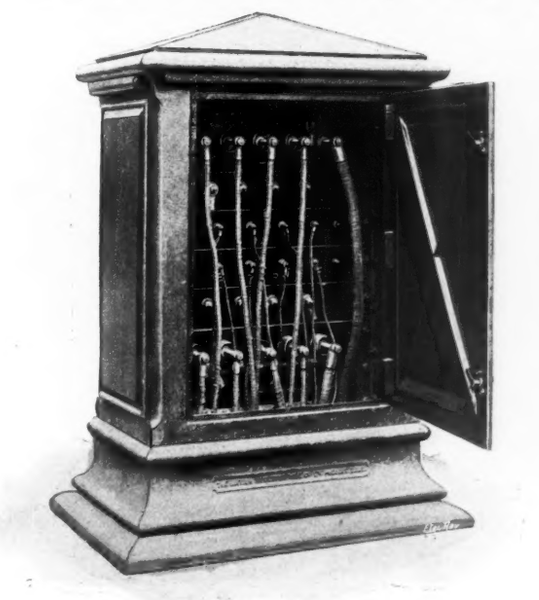
(*Concluded from page* 1052.)

The area supplied direct from the generating station is divided up into nine sections, each of which is separately



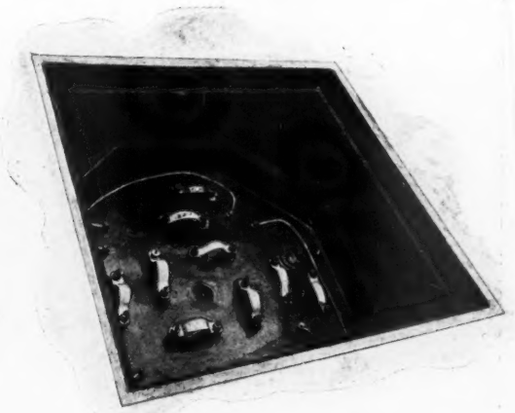
Manchester: Entrance to Cable Subway, Stuart Street.

fed; the sections, however, are coupled together by means of isolating fuses in disconnecting boxes, so as to confine the effect of a bad fault to the section in which it occurs. Fuses are also provided throughout the network. There are nine feeders, each of which is of the multiple core type, insulated with paper and lead covered; these, as well as the distributors, were all supplied by the British Insulated Wire Co., Ltd., to Mr. Blackman's detailed specifications. Each of the feeder cables has six cores, made up of three main



Poplar Back of Switch Pillar.

conductors, ·5, ·2, ·5 sq. in., and three pilot wires of 7/20 S.W.G. cable. The total length of feeder laid is about 13 miles. The network cable has five separate conductors, three being main distributor cables, ·2, ·075, ·2 sq. in., and two public lighting conductors, of 7/16 S.W.G.; one of the latter is used for the arc lamps in series, the other for switching on the glow lamps which replace the arc lamps at midnight. The length of the network cable laid is about 38 miles. The sections of cable used for feeders and distributors are shown in the cut on p. 1096; it is claimed that cables of this type are exempt from electrolytic troubles, as all the conductors are enclosed within a single lead sheath, while the combination forms a very strong and compact cable, convenient to handle in the



Poplar: Disconnecting Box.

laying. It is certainly a noteworthy fact that only one cable fault has been experienced since the opening of the works, and that one was due to a navvy's pick.

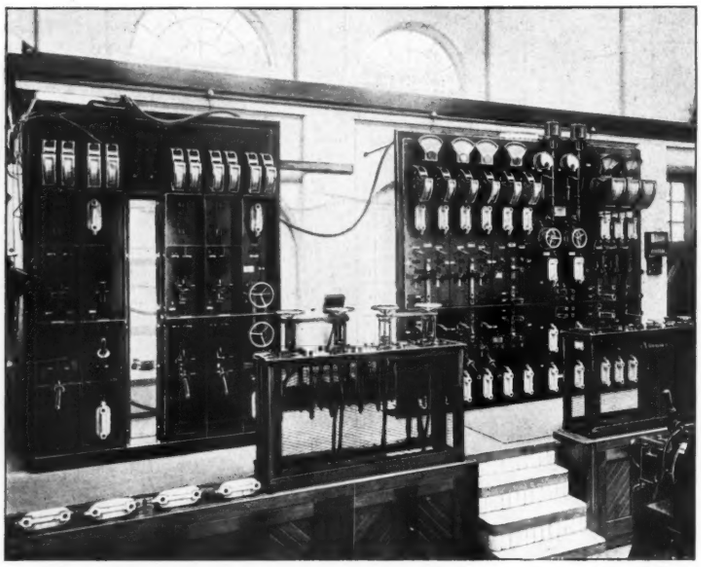
The cables are laid on the solid system, in glazed earthenware troughing with special spigot and faucet joints, filled in with pure pitch and covered with tiles.

To supply the Millwall area, which is completely isolated from the mainland by the West India Docks, special submerged cables have been laid.

Poplar: Front of Switch Pillar.

At the feeding points, the positions of which are indicated on the map on p. 1096, switch pillars above ground are used, supplied by the British Insulated Wire Co., Ltd.; one of these is illustrated herewith. We also give a view of one

of the disconnecting boxes, photographed in place; this is of a special form designed to suit the multiple-core cables, provided with exceptionally strong studs, conveniently arranged, and run in solid.



Main Switchboard in Reducer House.

House services are of the concentric type, ending on consumers' premises in a cast-iron fuse box with single-pole fuse, the mid-wire pole being without a fuse. Where unusually large loads are to be provided for, a piece of standard network cable is used, terminating in a special underground box just outside the consumer's premises; from this box single-core cables are led into the building.

For the public lighting, 115 7½-ampere, and 75 10-ampere Brockie-Pell arc lamps are used, and 130 7½-ampere Westinghouse-Bremer arc lamps are in course of erection. The last are of the magazine type, fresh carbons being automatically introduced up to the number of five.

The arc lamps are run in series of 10 off the 460-volt outers, with a connection to the mid-wire at the centre of each series. The Brockie-Pell lamps are spaced 60 to 70 yds. apart, and 20 ft. high, while the Bremer lamps, which distribute the light to great advantage, are 80 to 95 yds. apart and 23½ ft. high. To connect the arc lamps in circuit, the lead sheathing of the distributor is cut at each lamp standard, and the arc lighting cable is cut and joined to the service leads running into the lamp column.

Besides the arc lamps, there are 490 glow lamp lanterns for public lighting, which have been converted from gas lamps; the fitting used is illustrated on p. 1096. Each lantern contains two 16-c.p. 115-volt lamps in series, with a fuse, and the lamps are switched on in groups of 6 to 10.

The charges for private lighting are 5d. per unit for the first 91¼ hours' use of the maximum demand per quarter, and 3d. afterwards; for power the charges are 3d. and 1½d. on the same basis, all subject to a discount of 5 per cent. for cash. Power consumers of more than 250,000 units per annum are charged 1½d. per unit net. Ferranti meters are used, with Reason and Schattner demand indicators. During the year ended March 31st last, the consumption was, for lighting, 1,346,191 units: for power, 441,356 units: making a total of 1,787,547 units for the year; the net revenue was £22,649 10s. 5d.

The arrangement of the high-pressure transmission system for the supply of the docks is unusual, and further particulars of it may, therefore, prove interesting. The diagrams on the opposite page serve to illustrate the methods adopted.

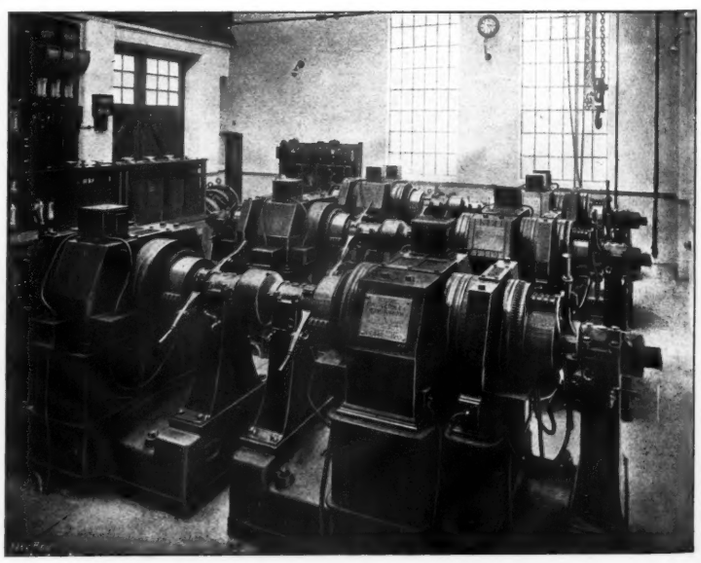
The reducer house is situated in Glengall Road, in the Isle of Dogs, adjoining the Millwall Docks. It is a brick building, with one end temporarily closed with galvanised iron to allow of extensions, and is provided with a 10-ton Morris & Bastert traveller. A switchboard platform, 11 ft. wide, runs along one side of the room.

The transforming plant, of which we give a view, consists of three sets, each comprising two motor-generators coupled together, and having a total capacity of 900 kw. There are also two balancers, and space is left for a fourth transformer. All the machines, as well as the switchgear connected therewith in the reducer house and the generating station, were supplied by the Electric Construction Co., Ltd., of Wolverhampton.

The transforming sets have double-wound armatures, with an auxiliary field magnet acting on the low-pressure winding only, so as to provide for the regulation of the voltage. Each reducer may, therefore, be looked upon as consisting of four machines, which are coupled up as shown in the diagrams of connections. It will be seen that the whole of the high-pressure current passes through the two motor windings, after which it reaches the low-pressure bus-bars and passes out, in common with the current generated in the two generator windings, to the network. Thus only two-thirds of the power transmitted at high pressure is actually transformed. The resulting efficiency of transmission is shown by the curves given on the next page.

The low-pressure machines feed direct to the outers of the three-wire network at 460 to 520 volts; the balancers provide for the middle wire. They also are of the auxiliary field type, and each is capable of dealing with an out-of-balance current of 200 amperes.

Separate switchboards for the high and low pressure systems are provided in the reducer house, as shown in one of the illustrations on this page. The former is on the extreme left, and is similar in construction to the corresponding board at the generating station, having two panels for the incoming feeders, and three for the reducer motors. The low-pressure board consists of five panels; three of these control the reducer generators, one carries the long-range automatic



E.C.C. Reducers.

switches for operating the balancers from the generating station, and the fifth controls the low-pressure feeders. At the front edge of the platform are the starting and regulating switches for the reducers.

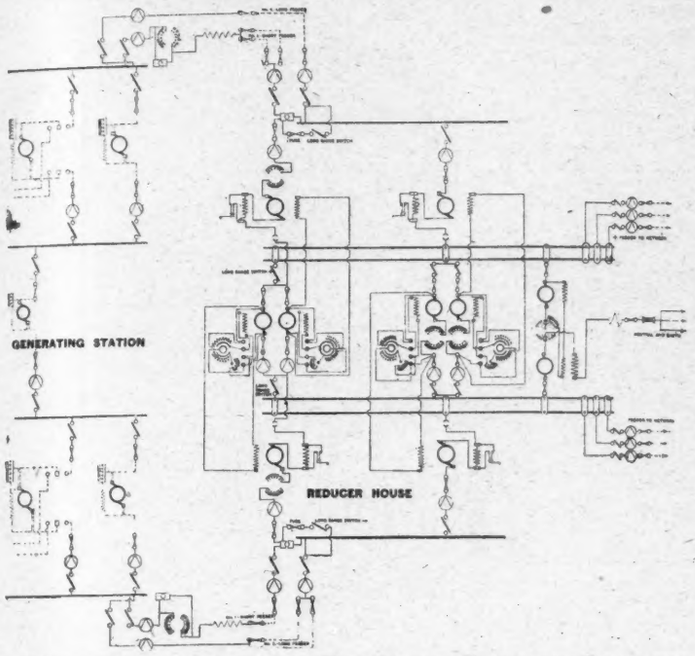


Diagram No. 1.—Connections of High Pressure Transmission System.

A separate board, seen in the view of the reducers, carries the switchgear for operating one line of reducers from the generating station at times of light load, so as to dispense with an attendant at the latter.

The method of operating the switchgear is very simple. Two of the reducers are started with rheostats from the low pressure side, but only one of these is shown in the diagrams; the fields of the motors (which are common also to the generators) are excited practically direct from the low-pressure bus-bars, while the auxiliary field is provided with regulating resistances, by means of which the speed and

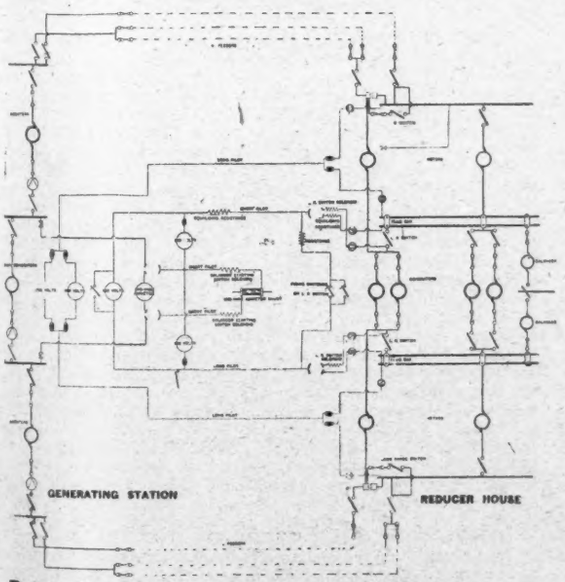


Diagram No. 2.—Connections of Switchgear for Controlling Reducer House from Generating Station.

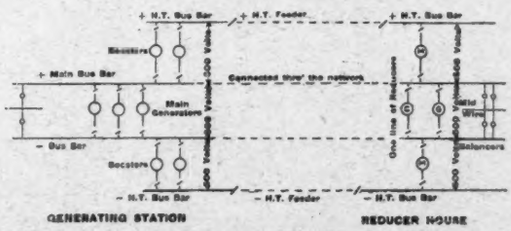
pressure of the motors are adjusted in the act of paralleling with the high-pressure bus-bars, and afterwards the pressure and load of the generators are controlled.

In the case of the third reducer, the starting rheostats are in circuit with the motors, next the high-pressure bus-bars, this set being always started up from the high pressure side, either by an attendant in the reducer house, or by manipulation of the switchgear in the generating station. The latter operation is effected by means of the feeders, and six pilot wires, which ordinarily serve to indicate at the main station the high and low pressure bus-bar voltages and the out-of-balance current of the reducer house. Before the attendant leaves the latter, he cuts out all the starting resistance there, and leaves the switches so disposed that upon switching on the feeder at the main station and gradually cutting out the starting resistance at the latter, the reducer set runs up to speed.

In ordinary running the two outer "long pilot" wires are used for showing, at the main station, the voltage of the high pressure bus-bars in the reducer house, which is always kept at 1,450 volts. For paralleling purposes, these pilots are coupled to the low pressure bus-bars by means of the voltmeter plugs shown, before the attendant leaves the reducer house.

The two two-way switches labelled "L.R. switch solenoid," in the reducer house (diagram No. 2), are mounted upon the main field magnets of the reducers, and are actuated by their stray field when the machines are run up from the generating station; when this takes place, they connect the pilot leads with the terminals of the generators through the long range switch solenoid, at the same time showing at the main station the voltage of the generators. The primary pressure is adjusted until the secondary pressure is equal to that of the bus-bars, and the voltmeter is then short-circuited by means of the "firing" switch shown in the diagram, causing the solenoid of the "long range" switch, in the reducer house, to close the main switches connecting the motors and generators with the respective bus-bars. Similarly, either or both of the balancers can be run up and coupled to the mains by means of the switches shown next to the "mid-wire ammeter" on diagram No. 2. The pilot wires used for the purpose last mentioned are connected one on either side of a special shunt resistance, in circuit with the middle wire at the reducer house, and by coupling them to a moving-coil ammeter at the main station, they serve to indicate at the latter the out-of-balance current at the former.

The long-range switches referred to above are of two kinds. One type, used for starting the balancers, actuates a rheostat with half-a-dozen contacts, and is provided with a dashpot to give a slow motion over the period of acceleration. When the switch is operated a second time the balancer is stopped, and so on. The other kind simply



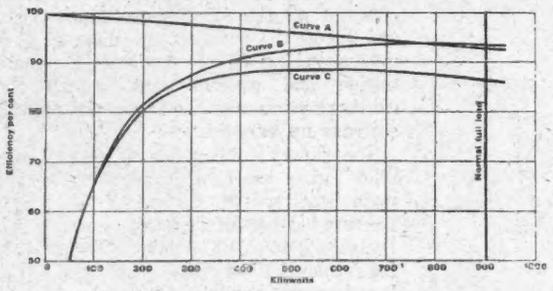
General Arrangement of Transmission System.

actuates the four-pole switches which connect the motors and generators with the corresponding bus-bars.

The system has worked quite satisfactorily since its installation, and the machines, which are provided with continuous lubricating devices, run practically without attention. There is a large and increasing demand for power in the adjoining docks, and this has been efficiently met by the arrangement described.

Thanks no doubt to the large proportion of energy taken by power consumers, the cost of generation at Poplar is remarkably low—almost the lowest, in fact, among the metropolitan boroughs. During the past year—the second year of working—1,787,547 units were sold. The fuel cost per unit sold was ·56d., and the total works costs were 1·02d.; the total costs, exclusive of capital charges, were

1·45d., and the average price received was 2·74d. per unit. Certainly the consumers are to be congratulated upon the very low price at which they are supplied with electrical energy; only one other borough charges less than 3d., namely, Stepney, where the price is practically the same,



Curve A, line efficiency. Curve B, reducer efficiency. Curve C, over-all efficiency of transmission.

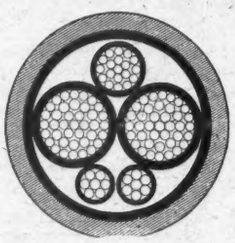
Efficiency of Transmission System.

and the latter obtains part of its steam supply from a refuse destructor.

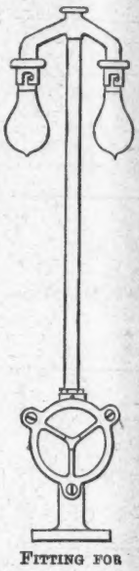
Map of Area Supplied.

The capital outlay to date is £194,537, divided as follows:—Land, £3,123; buildings, £25,786; machinery in generating station, £43,045; rotary transformers, £8,834; accumulators, £2,511; mains and services, £89,922; meters and indicators, £3,186; public arc lighting, £12,513; public incandescent lighting, £2,075; minor expenses account for the remainder.

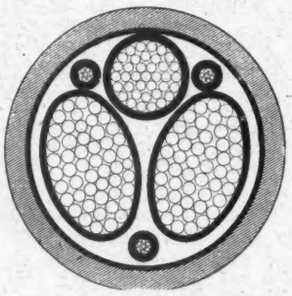
Having regard to the nature of the area supplied, and especially to the splendid field for motive power supply in the docks and warehouses of the Isle of Dogs, there is every prospect that the undertaking will continue to prosper, and that the remarkable success which it has attained in its first



Section of Distributor.



Fitting for Converted Gas Lantern.



Section of Feeder Cable.

two years will be far outshone when its development has arrived at the scale warranted by the circumstances.

In conclusion, we have pleasure in acknowledging the generous assistance which we have received from the borough electrical engineer, Mr. Alfred Blackman, and his assistants, Messrs. D. M. Macleod and T. Roles, in the preparation of this article.

TELEGRAPH AND TELEPHONE NOTES.

(*Continued from page* 1084.)

French Submarine Cables.—The *Times* Paris correspondent quotes from an article in the *Dépêche Coloniale* calling attention to a Parliamentary report on the important question of submarine cables. The desirability of linking France with her colonies by means of a direct telegraph has been fully recognised of late years. Various proposals to that end have been laid before Parliament. In 1901 the French Government moved a step in that direction by establishing a line from Oran to Tangier and from Turan to Amoy, and by purchasing from the West African Telegraph Co. a series of cables which now unite Dakar to Konakry, Grand Bassam to Kotonu, and Kotonu to Libreville. These lines are at present worked by the Government. The next step was taken in October last, when the Minister of Commerce provisionally accepted estimates for the laying down of cables from Brest to Dakar, from Saigon to Pontianak, and between Tamatave and the islands of La Réunion and Mauritius. The contract price was 22,975,000 fr. As it was necessary for the project to receive the sanction of Parliament, a Bill was introduced into the Chamber last March by M. Trouillot, Minister of Commerce, in conjunction with M. Rouvier, Minister of Finance, and M. Bérard, Under-Secretary of State for the Postal Department. The Bill authorised an annual charge on the Budget for 35 years of 1,278,000 fr. for the establishment and organisation of a submarine cable system. The proposal was sent to a Parliamentary Committee, which, in the report above referred to, unanimously approves the principle of the undertaking and recognises its urgency.

Indian Cable Rates.—Cable rates between India and Europe having been reduced in March, 1902, substantial reductions have now been made in the rates between India and Australia and the Pacific Islands.

The Pacific Cable.—Mr. Chamberlain replied to a House of Commons question put by Sir J. Colomb the other day as follows:—The cost of special surveys is not included in the capital outlay in connection with the Pacific cable. The soundings made by the surveying ships of the Royal Navy on the route of the cable, though of great value, were incidental to and made in the course of their ordinary operations. The special detailed survey required for the determination of the exact route to be followed by the cable was carried out not by the Royal Navy, but by the contractors for the construction and laying of the cable. The sea route of the

Pacific cable is that recommended by Lord Selborne's Committee That Committee left open the choice between Fanning and Palmyra Islands for the mid-Pacific landing place, but Fanning Island was found on further investigation to be the preferable station. The question of a connection with the United States cable at Honolulu has been raised, but no action has yet been taken in that direction. The interruptions which have taken place in through telegraphic communication, *viâ* Canada, between the United Kingdom and Australia have been confined to the Vancouver Island land lines, the western section of which was specially laid by the C.P.R. for the purposes of the Pacific cable.

The Ottawa correspondent of the *Times* says that the recent correspondence from Sir John Cockburn and Sir Horace Tozer on the Pacific cable question has attracted widespread attention in Canada. "Sir Sandford Fleming says that the difficulty with the Eastern Extension Co. was originally caused by New South Wales, and the Commonwealth inherited it. There is one solution, he thinks, which New South Wales can urge, the Commonwealth can offer, and Canada and the other partners in the cable can accept. It is to extend the principles of State ownership to a single cable across the Indian and Atlantic Oceans, so as to constitute an Empire-girdling State-owned telegraph service. This, Sir Sandford Fleming considers, would remove the friction which, without it, must continually exist."

Queenstown.—In the past week H.M.S. *Monarch*, submarine cable ship, was employed in laying a cable from Haulbowline Dockyard, Queenstown, to the signal station at Roche's Point, where a Marconi apparatus is in operation.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Latakia-Cyprus	June 20, 1899	
Trinidad-Demerara No. 1	Aug. 27, 1901	
Trinidad-Demerara No. 2	June 9, 1903	
Dominica-Martinique	May 8, 1902	
St. Lucia-Martinique	May 8, 1902	
Guadeloupe-Martinique	May 9, 1902	
Martinique-Puerto Plata	July 10, 1902	
Cayenne-Pinheiro	Aug. 13, 1902	
St. Lucia-St. Vincent	Sept. 19, 1902	
Reissa-Issa	Oct. 22, 1902	
Reissa-Yemani	Oct. 22, 1902	
Paramaribo-Cayenne	Feb. 27, 1903	
New York-Haiti	April 18, 1903	
Assab-Massowah	June 1, 1903	
Landlines.		
Dagua-Buenaventura	June 22, 1903	
All communication with Tonkin interrupted by reason of typhoon	June 9, 1903	June 22

Wireless Telegraphy.—The *Daily Graphic* of 18th inst. published a letter addressed to them by Mr. Cuthbert Hall, managing director of the Marconi Co., who takes exception to their statement as to the failure of wireless telegraphy apparatus in Somaliland. Mr. Hall states: "It is as absurd to take wireless apparatus off a ship and expect it to work well overland as it would be to expect submarine telegraph instruments taken from a land station to work satisfactorily on a ship." We are to understand by this that the mirror speaking and Morse instruments used on cable ships cannot be used to work cables from stations! Mr. Cuthbert Hall knows better than this.

CONTRACTS OPEN AND CLOSED.

OPEN.

Aberdare.—July 11th. The U.D.C. wants tenders for the installation of fire call bells. Particulars at the Surveyor's Office, Town Hall.

Aberdeen.—Electrical equipment of the Torrey tramway route. See "Official Notices" June 19th.

Batley.—July 3rd. Tramway panels and Highfield booster for the electricity works. See "Official Notices" June 19th.

Coventry.—July 2nd. Pipework, economiser, coal-conveying plant, stokers and sundries, for the electricity works extensions. See "Official Notices" June 19th.

Darlaston.—June 29th. Electric wiring and fittings for the Town Hall Buildings. See "Official Notices" June 19th.

Dewsbury.—July 1st. One Lancashire boiler for the electricity works. See "Official Notices" June 19th.

France.—July 2nd. Tenders are being invited until July 2nd by the French Post and Telegraph authorities for the supply of a quantity of insulated electric cables. Tenders are to be sent to Le Sous-Secretariat d'Etat des Postes et des Telegraphes, Rue de Grenelle, 103, Paris, whence particulars may be obtained.

France.—July 7th. The French Ministry of the Colonies is inviting tenders until July 7th for the supply of 100 tons of annealed and galvanised iron telegraph wire for Indo-China. Particulars may be obtained from, and tenders are to be sent to, Le Ministere des Colonies, 4 bis, Rue Jean Nicot, Paris.

Govan.—June 29th. Steam piping, electric pump, &c. See "Official Notices" June 12th.

Hammersmith.—July 15th.—Forty alternating current arc lamps, &c. See "Official Notices" to-day.

Hornsey.—Electric wiring and fitting at the Council's offices. See "Official Notices" June 19th.

Hungary.—August 31st. Tenders are being invited until August 31st next by the municipal authorities of Besztercebanya (Neusohl) for the establishment in the town of a central electricity generating station of a capacity of 500 H.P.

Ipswich.—July 14th. Electricity meters. See "Official Notices" to-day.

Launceston (Tasmania).—September 28th. 500 or more electric meters. See "Official Notices" June 12th.

Leek.—July 9th. Switchboard, balancing transformer and motor-generators, battery, crane. See "Official Notices" June 19th.

Middlesbrough.—July 4th. Underground mains, road work, &c. See "Official Notices" June 19th.

New South Wales.—September 12th. Tenders are being invited by the Railway Commissioners for New South Wales, for an additional generating set of 1,500 KW. for their tramway power station.

Norwich.—July 8th. Cables, meters, accessories, pump and motor. See "Official Notices" to-day.

Pietermaritzburg.—July 6th. Cables, feeder and junction boxes, cable terminals and telephones for electric tramways. See "Official Notices" June 19th.

Poplar.—July 8th. Arc lamp carbons. See "Official Notices" to-day.

Portugal.—October 21st. Tenders are being invited until October 21st by the Portuguese Ministry of the Colonies in Lisbon for the concession for the electric lighting of the town of Macao in the Portuguese Colonies.

Rangoon.—July 1st. The Municipal Committee wants tenders for carrying out its electric lighting license, and particulars, forms, &c., can be obtained from the officiating secretary (W. Shircore), Rangoon municipality, at Rs. 75 per set.

St. Pancras.—July 2nd. Wiring the St. Pancras Infirmary for the Guardians. "See "Official Notices" June 19th.

St. Pancras.—July 8th. Wiring the Godlington Buildings, Gt. College Street, for the Borough Council; also supply of cable to Electricity Department. See two "Official Notices" to-day.

St. Pancras.—July 14th. 350,000 carbons (12 months' supply). See Official Notices" June 19th.

St. Pancras.—July 14th. Electric jenny and crab. See "Official Notices" to-day.

Saltburn.—Storage battery for the Cleveland Trust, Ltd. See "Official Notices" June 19th.

Spain.—July 10th. Tenders are being invited until July 10th by the Spanish Post and Telegraph authorities for the supply and laying of a submarine telegraph cable between the Spanish possession of Fernando Po and the German Colony of Kamerun. Tenders are to be sent to La Direccion, General de Correos y Telegrafos, Carretas, 10, Madrid, whence particulars may be obtained.

Stepney.—July 21st. Pipe work, water softening plant, and storage tanks, for the electricity works. See "Official Notices" to-day.

Swindon.—July 1st. Wiring the Technical School. See "Official Notices" June 19th.

West Ham.—July 14th. High-tension feeders and other cables. See "Official Notices" June 19th.

Weymouth and Melcombe Regis.—July 19th. Boilers, engines and dynamos, and various other plant for electric lighting. See "Official Notices" to-day.

CLOSED.

Battersea.—The B.C. has placed an order with the Gilbert Arc Lamp Co., Ltd. for providing double carbons to 112 electric arc lamps, at £235.

The tender of Callender's Cable & Construction Co., Ltd., to supply at schedule rates, articles and materials required in connection with the extension of electric mains, has been accepted at £1,148.

Croydon.—The Corporation has accepted the tender of the British Insulated and Helsby Cables, Ltd., for cables in connection with the direct current supply, the amount of the contract being £1,039. The Corporation has also accepted the tender of Messrs. E. Goossens, Pope & Co., for the supply of 3,741 incandescent lamps of various candle-powers.

Dundee.—The Corporation, on Mr. Richardson's recommendation, has decided to erect an oil filtering apparatus of the Harris Patent Feed Water Co.'s make, capable of dealing with 4,000 gallons per hour, in the electricity works. At a meeting of the Tramways Committee on Monday it was decided to accept the tender of Messrs. Crompton & Co., Chelmsford, for a large balancer booster.

Fife and Kinross Asylum, Cupar.—Messrs. Lowdon Bros. & Co. have ordered three engines for direct coupling to Mavor and Coulson continuous current dynamos for this installation.

Glasgow.—The offers of Messrs. Crompton & Co., Ltd., and Messrs. De Grelle, Houdret & Co., for the supply of carbons for the year ending May 31st, 1904, have been accepted.

Heysham.—The Electrical Power Storage Co., Ltd., has received the sub-contract for the storage battery for the Heysham Harbour Works from the British Westinghouse Electric and Manufacturing Co., Ltd.

Huddersfield.—The Electricity Committee has accepted the tender of Messrs. Schofield & Taylor, Turnbridge, Huddersfield, for a jet condensing plant (£600).

Manchester.—The order for the starting switches for use with motors supplied by the Corporation on the hire system, has been placed with Veritys, Ltd., who also hold the contract (second year in succession) for the Salford Corporation motor starters.

Morecambe.—The T.C. has accepted the tender of Messrs. Ledward & Co., for the supply of a condenser for the electricity works.

Stepney.—The New Century Arc Lamp Co. have accepted the tender of Messrs. Rowland Carr & Co., for 60 arc lamp pillars, required for the contract they have for Stepney arc lighting.

Wednesbury.—The following tenders have so far been accepted in connection with the Corporation's electricity supply scheme to the specifications of Mr. F. J. Warden-Stevens:—Phœnix Dynamo Manufacturing Co., of Bradford, for motor-generators; British Westinghouse Co., for battery boosters; British Accumulator Co., of Westminster, for accumulators; W. Sanders, of Wednesbury, for switchboards; W. T. Glover & Co., Ltd., for cables.

West Ham.—The Council has accepted the tenders of the Vulcan Electric Co. for the electric lighting and fitting of the Holborn Road and Napier Road Schools, at £695 and £578 respectively.

Wigan.—The T.C. has accepted the tender of the Commercial Electric Co. for the supply of 1,200 16-c.p. electric lamps, and that of the B.I. and Helsby Cables, Ltd., for cable.

Wolverhampton.—The installation of electric light, telephones, and lightning conductors for the new Women's Hospital, has been placed with the District Electric Co., Wolverhampton.

Worksop.—The Electrical Co. has ordered one 220-H.P. engine for direct coupling to continuous current dynamo from Bellliss & Morcom, Ltd.

FORTHCOMING EVENTS.

Friday, June 26th.—At 5 p.m. Physical Society. "Science" meeting, to be held in the Physiological Laboratory, University of London, South Kensington. "Electrical Effects of Light upon Green Leaves," by Dr. A. D. Waller; "Blaze Currents (1) of a Vegetable Tissue; (2) Of an Animal Tissue," by Dr. Waller; "On the Movement of Un-ionised Bodies in Solution in an Electric Field," by Dr. Hardy.

[At 4.30 p.m. a special general meeting of Fellows is to be held for adopting certain Articles of Association.]

At 7.30 p.m. Junior Institution of Engineers. Meeting at the Finsbury Technical College. Mr. R. P. Howgrave Graham will deliver a lecture illustrated by experiments on "High Frequency Electric Discharges."

Monday, June 29th.—At 6.30 p.m. Junior Institution of Engineers. Visit to Messrs. John Bennett Lawes & Co.'s Atlas Works, West Ferry Road, Milwall.

Tuesday, June 30th.—At 8 p.m. The Faraday Society. Meeting in the rooms of the Chemical Society, Burlington House, Piccadilly, W. The Council will submit the Rules which they have drawn up for adoption:—The following papers will be read:—"The Present Position of the Theory of Electrolysis," by W. C. Dampier Wnetham, F.R.S.; "Chlorine Smelting, with Electrolysis," by James Swinburne, M.I.C.E.; "Total and Free Energy of the Lead Accumulator," by R. A. Lehfeldt, D.Sc.; "Electrolytic Apparatus," by F. Mollwo Perkin, Ph.D.

Thursday, July 2nd.—At 8.30 p.m. Röntgen Society, 20, Hanover Square. Annual meeting. [The names to be balloted for include Lord Blythswood for the presidency, and Dr. C. W. Mansell-Moullin and Prof. S. P. Thompson as Vice-Presidents.]

Monday, July 6th.—At 11.45 a.m. At Earl's Court. Opening of the Fire Prevention Congress by the Lord Mayor.

THE ST. MARYLEBONE IMPASSE.

We have to record another development in the proceedings incident upon the compulsory purchase of the Metropolitan Electric Supply Co.'s undertaking within the borough of St. Marylebone. As our readers are probably aware, the Borough Council of this district in 1901 promoted a Bill in Parliament in order to obtain powers to take over the property of the company. This Bill was passed as the Electric Lighting Order Confirmation (No. 1) Act, 1901, and by Sec. 2 it was provided that the company should sell, and that the Council *might and should* purchase the St. Marylebone undertaking and business of the company as thereinafter defined, with the exception of certain offices and the extra high pressure trunk mains of the company for such purchase money and consideration being a sum in gross, and on such terms and conditions as might be agreed upon between the company and the Council, or, failing agreement, as might be determined by arbitration in manner provided by the Lands Clauses Acts with reference to the purchase and taking of lands otherwise than by agreement. The parties having failed to agree to the amount, the matter was referred to arbitration, and after a protracted hearing an award was made to the effect that the price should be £1,212,000. Seeing that the price claimed was £2,750,000, this does not appear to be an excessive figure. But, as might have been expected, the representatives of the ratepayers found that they had been committed to a policy from which they would be glad to retreat, and they therefore took steps to ascertain whether it would not be possible to set aside the award. Counsel having advised against this, there was nothing for it but to apply to the Local Government Board for leave to borrow the necessary sum.

The Finance Committee of the London County Council has reported that the St. Marylebone Borough Council applied for sanction to the borrowing by it of £1,274,000 for the purchase of that portion of the undertaking of the Metropolitan Electric Supply Co., Ltd., which was within the borough, and which the borough was authorised to purchase by the Electric Lighting Order Confirmation Act of 1901, and for costs in connection with the purchase. The Committee had had before it a deputation of the Borough Council in support of its application for sanction to the loan, and also a deputation from ratepayers in the borough in opposition to the application. The solicitor had advised it that it was not possible for the Council to sanction the proposed loan without further statutory authority being given to the Borough Council authorising it to borrow, and Mr. Haldane, K.C., confirmed that view. In the circumstances it recommends that the application for the loan be not granted. The result of this is that, before the Metropolitan Electric Supply Co. can get their money, or any part of it, a new Bill must be presented to Parliament; and unless Parliament sanctions the loan, it is difficult to understand what the position will be. Under the Act of 1901, the Borough Council is bound to acquire and pay for the undertaking in question, and the company are bound to execute the necessary conveyance. If the purchase price is not forthcoming, the company must presumably be entitled to bring an action for damages for breach of contract, unless, of course, the whole of the proceedings to date have been conducted upon the understanding that the liability of the Council was subject to the consent of the Local Government Board.

We shall await with interest the future developments of this "leading case" against municipal trading.

Electricity on Canals.—It is reported that Sir William Tomlinson, Mr. J. Briggs and other members of Parliament, have made representations to the Board of Trade in favour of the principal provisions of the Railways (Electrical Powers) Bill being extended to canals. The measure proposes to enable railway companies to issue new capital and acquire land with a view to the use of electrical traction, and it is understood that this would apply also to canals owned by railway companies.

ADDENDA TO ELECTRICITY SUPPLY WORKS LISTS.

PROVINCIAL.

LONDONDERRY.—Capacity of plant, 180 KW. Capital exp., £18,942. Units sold, 261,535; works costs, 2·27d.; total costs, 3·17d. (public arc lighting only). Pr. ltg., scheme sanctioned and contracts placed, £35,000.

PENARTH.—Add 1 B. & W., 1 Allen-Brush. Total capacity, 210 KW.; max. load, 70 KW. Pr. ltg., 3,230; lamps added, 839. Units sold, 31,962. Price obtd., 4·54d.; works costs, 2·95d.; total costs, 5·65d. (? incl. cap. charges).

WESTON-SUPER-MARE.—5 B. & W., cond., clg. tr. 2 Universal, 2 Browett-Lindley eng.; 3 Brush, 1 Siemens & Halske, 800 KW.; max. load, 264 KW. ltg. & tr. Battery Pollak, 576 a. h. Capital exp., £54,615. Pr. ltg., 9,666; lamps added, 3,644. Price chgd. pr. 4½d. & 1½d. Units sold, 200,396 (inc. 102,453 traction). Price obtd., 4·71 ltg., 4·03 pr., 2d. tr.; works costs, 1·77d.; total costs, 2·48d.

LONDON.

PLUMSTEAD.—Woolwich Borough Council. Opened 1903. Engineer, J. B. Mitchell. Supply pressure, 460 & 230 V., D.C. 4 B. & W., econ., cond., clg. tr. 6 Willans-Westinghouse, 650 KW. Battery, Brit. P. T. & L. Co, 392 a.h. Mains, Callender v. bit. solid. Capital exp., £60,000. Pr. ltg., 3,017; lamps added, 2,036. Pb. ltg., 77 arc + 2 inc. each. Motors, 5 = 23·5 H.P. Price chgd., ltg. 4d., or 7d. & 2½d.; pr. 2d. to 1½d. 3 Meldrum destructors.

WOOLWICH.—W. Boro' Ccl. Opened 1893. Engineer, J. B. Mitchell. Supply pressure, 420 and 210 V., D.C. Four Economic, 4 Paxman loco.; 4 Parsons turbo-dynamos, 1 Allen, 1 Bumsted-Easton Anderson, 910 KW.; max. load 569 KW. Triple conc. armd. fdrs., 3-core dist. Callender v. bit. in c.i. pipes and solid. Cap. exp., £98,000. Pr. ltg. 23,899; lamps added 6,326. Motors 22 = 213 H.P. Price chgd., ltg. 4d., or 7d. and 2½d.; pr. 2d. to 1½d. Purchased fr. Co. Jan. 1st, 1901, taken over Feb., 1903.

NORTH METROPOLITAN ELECTRIC POWER SUPPLY CO.—Delete Barnet. Sec., R. Doyle.

NOTES.

The I.E.E. (Calcutta Section).—We have received from the hon. sec. of the Calcutta Local Section of the Institution of Electrical Engineers a copy of the *Journal* (No. 1, vol. iii.) containing report of the proceedings of the annual general meeting, held on November 28th, 1902, and adjourned to the following month, together with the proceedings of the first ordinary meeting of the third session, held on March 27th, 1903. The secretary's report presented to the adjourned meeting is terse and informing. "The future" seems to have offered some grounds for despondency, but the concluding paragraph reports that "since the above was written two papers have been received, one by Prof. Bruhl, now being published, and one by Messrs. Styan and Shields." The paper by Prof. Bruhl is contained in the *Journal*, and makes amends for any previous shortcomings of the section. It is "On the Preservation of Instruments and Machinery in Bengal," but covers wider ground than is indicated in the title. The construction and packing of machinery so as to be adapted for use in India are dwelt upon, and the apparently forbidding subjects are so handled as to be not only interesting, but also amusing. We have tried to abstract this paper, but have hesitated to sacrifice any portion, and will publish it in full in an early issue.

Electrical Coal-Cutting Machines. — Before the Mining Institute of Scotland recently in connection with a paper previously read by Mr. F. W. Hurd on "Electrical Coal-Cutting Machines," Mr. P. G. E. Kennedy, of Wypen Colliery, near Coventry, gave some results of comparisons and tests with regard to the bar and disc coal-cutting machines. In the uses which had come under his notice the power absorbed by a bar machine for driving purposes was generally about one-half that necessary for the disc machine. Sometimes, on rare occasions, the power would be two-thirds as much, but never more. As between the disc and bar coal-cutter, the latter had one decided advantage in respect of the increased life of its gearing. Mr. Kennedy said that during the last nine years he had been in personal contact with nearly all the most successful coal-cutters in England, and his opinion was that the average life of the main gearing in a disc machine was not more than from six to eight months, even under the most favourable conditions. This did not compare at all favourably with the bar machine. He knew one of the latter type which had been working night and day for the past 22 months without a breakage of any kind.

Radium.—M. Pierre Curie delivered a lecture on "Radium" before the Royal Institution last Friday in the presence of a distinguished audience. The lecturer spoke in French and met with an excellent reception.

Crompton & Co., Ltd.—Last Saturday, on the invitation of the chairman and directors of this company, a considerable number of visitors foregathered at Chelmsford, for the purpose of inspecting the works, followed by the annual athletic race meeting of the Arc Works Club. Reserved saloon carriages were attached to the 10 55 train from Liverpool Street for the convenience of the London guests. Immediately after their arrival they were taken over the Arc Works, and the various apparatus were seen in the process of manufacture. When the company had gone through the various well-lit shops, luncheon was served in the new club building, after which the chairman of the company, Mr. John Trotter, proposed the toasts of "The King," and "The Mayor," and Mr. Alderman Taylor proposed "Success to Crompton & Co., Ltd." Replying, the chairman mentioned the cordial relations existing between the company and its men, and referred to the new club building which had been erected, and to the continued growth of the company's business. He added that we were often told by our friends across the Atlantic that the Britisher was old-fashioned and effete, and must adopt new methods. He did not believe half of that. He did not believe that England was behind other nations in cultivating new methods. Other nations, at times, went ahead faster. They wanted to make money too fast, with the result that they had setbacks, and when the slump came they found themselves at the bottom of it, whereas English manufacturing industries in such cases were not so much affected. Major Rasch, M.P., proposed "The Ladies," and Colonel Crompton responded, and referred to the success which had attended the introduction of girl labour into the works. There were a number now employed in the lighter work of the instrument shop.

An excellent programme of sports—walking, running, cycling, tug-of-war, &c.—was successfully carried through. The prizes were distributed by Mrs. Crompton to the following winners:—

300 yards flat, under 17.—1, A. G. Wilks; 2, E. Love; 3, T. Skingley.

Half-mile flat.—1, R. C. Stannard; 2, H. Mason; 3, E. Sparkes.

Mile bicycle.—1, H. P. Girling; 2, A. F. Bearsby; 3, R. P. Hulton; 4, B. R. Brown.

Mile walk.—1, H. Martin; 2, G. A. Taylor; 3, A. C. Benson.

Quarter-mile flat championship.—1, A. J. Leathers (holder); 2, W. Howes; 3, J. E. Porter.

100 yards flat, over 40.—1, W. Saltmarsh; 2, R. C. Wilks; 3, E. Warder.

120 yards hurdle handicap.—1, A. G. Wilks; 2, H. F. Wilson; 3, E. A. Rust.

100 yards flat, under 17.—1, F. Lucking; 2, S. A. Rose; 3, A. G. Wilks.

Two miles bicycle championship.—1, H. P. Girling (holder); 2, J. A. Wilks; 3, E. E. Dyer.

100 yards flat.—1, J. L. Owen; 2, A. J. Leathers; 3, E. G. Newman.

Half-mile bicycle handicap.—1, R. P. Hulton; 2, A. F. Bearsby; 3, D. A. Dunham.

Mile flat championship.—1, E. H. Barnes (holder); 2, R. C. Stannard; 3, H. Mason.

100 yards flat championship.—1, J. L. Owen; 2, A. J. Leathers (holder); 3, W. Howes.

220 yards flat.—1, C. R. Lambert; 2, A. J. Leathers; 3, B. E. Smee; 4, W. Howes.

Mile flat.—1, H. Mason; 2, R. C. Stannard; 3, J. Wilkinson; 4, A. B. Dickson.

Comical race.—1, W. Berry; 2, S. Britton; 3, W. Warder. Best costume: S. Britton.

Tug-of-war.—A. Suckling, C. S. Capel, H. Rolph, F. Bryan, Bradley, W. G. Bickmore, W. Lee, and A. J. Young.

Two miles bicycle handicap.—1, H. P. Girling; 2, B. R. Brown; 3, A. F. Bearsby.

The Royal Society's Catalogue of Scientific Papers.—The Royal Society has just received from an anonymous source a donation of £1,000 towards the fund of £12,000 which is being raised to enable the society, without further expenditure of its own resources, to complete the catalogue of the scientific papers of the last century (upon which it has been engaged for so many years and has expended so much money), so as to link it with the International Catalogue of the Scientific Literature of the present century. It will be remembered that the fund was started by a munificent donation of £6,000 from Dr. Ludwig Mond, F.R.S., which was followed by one of £1,000 from Mr. Andrew Carnegie. A contribution of £367 10s. has since been received from "F.R.G.S.," and others of various amounts from Fellows of the Royal Society. The total amount already received or promised is £8,636.—*Times*.

The Mosely Industrial Commission to U.S.A.—We are informed that Mr. Alfred Mosely has just made arrangements with Messrs. Cassell for a reprint of the complete Reports of this Commission in cheap form. Copies may be had from Messrs. Cassell & Co., Ltd., Ludgate Hill, E.C., at 6d. each net, or post free 9d.; and application should be made to them before July 1st, the edition being limited. This cheap edition is being produced by Mr. Mosely not only without profit but at a loss, and solely in order that the public may be enabled to possess themselves of the knowledge gained from the inquiries made in the United States. The Board of Trade has ordered 3,000 copies for free distribution.

Personal.—Mr. H. Allcock, A.I.E.E., of Glovers, Trafford Park, was presented with a handsome clock by the members of the staff on the occasion of his marriage which took place this week.

The Engineering Trades and Preferential Tariffs.—The *Times* on Tuesday published the following in its "Political Notes" column:—"Amongst business men in the great industrial centres in sympathy with Mr. Chamberlain's preferential tariff proposals, there is a strong feeling that, to bring the new movement to a successful issue, more is needed than the mere passing of resolutions. The appeal of the Cobden Club for funds to promote free trade propagandism in the constituencies, coupled with the known intention of the Liberal organisers to utilise the approaching recess for a campaign of a far-reaching character, must, it is recognised, be met by kindred tactics. Accordingly, a war chest, supplementary to that controlled by the Conservative central office, is required, in order that there may be a vigorous crusade in favour of the Colonial Secretary's scheme. To this end a conference of members of Parliament and others interested in the iron, steel, engineering and electrical manufacturing trades will be held in one of the committee rooms of the House of Commons on Thursday. Sir Bernard Samuelson has consented to preside, and amongst those expected to attend are Sir A. Hickman, M.P., Sir T. Wrightson, M.P., Mr. Arthur Keen (Guest, Keen & Nettlefolds), Sir Joseph Lawrence, M.P., Mr. E. Windsor Richards (Bolckow, Vaughan & Co.), Mr. J. H. Lukach (British Westinghouse Electric and Manufacturing Co.), Mr. Parkes, M.P., Mr. Baldwin, M.P., Col. C. Allen (Henry Bessemer and Sons), and Mr. J. W. Spencer (John Spencer & Sons), Newcastle."

The *Times*, in the same column on the following day, says:—"We are requested to state that the first object of the conference of members and others interested in the iron, steel, engineering, and electrical manufacturing trades which is to be held in one of the Committee rooms of the House of Commons to-morrow is, according to the convening circular, 'to consider' Mr. Chamberlain's preferential tariff proposals. Attendance at the meeting will, therefore, in no sense carry with it an obligation to support the new scheme; and, of course, no steps will be taken for starting a campaigning fund unless a general desire is manifested to assist in repelling the Liberal attack upon Unionist seats."

London County Council.—The Council at the meeting on Tuesday received a report from the Finance Committee referring to the application made by the Marylebone Borough Council for sanction to borrow £1,274,000 for the purchase of the Marylebone section of the undertaking of the Metropolitan Electric Supply Co., as authorised by the Electric Lighting Order Confirmation (No. 1) Act, 1901. A deputation from the Borough Council had appeared before the Committee in support of the application, and a second deputation from ratepayers had come forward in opposition. The solicitor had advised the Committee that it was not possible for the Council to sanction the proposed loan without further statutory authority being given to the Borough Council empowering it to borrow, and Mr. Haldane, K.C., who had been consulted on the subject, confirmed this view. In these circumstances the Finance Committee recommended the Council not to sanction the loan.

The Highways Committee were authorised to take steps to oppose before the Light Railway Commissioners the application of the Harrow Road and Paddington Tramways Co. for an order to authorise the construction of light railways specified in the Harrow Road and Willesden Light Railways (and Lands) Order, so far as the projected lines would be situated in London.

The Council recently decided to require the Kensington and Knightsbridge Electric Lighting Co. to provide and maintain stations for the testing of energy supplied to consumers. As the Highways Committee were informed that the Brompton and Kensington Electricity Supply Co. were prepared to make similar arrangements for testing stations, the Council resolved to serve a notice on the company formally requiring it to do so.

The Building Act Committee reported that sanction had been given to plans submitted by the Charing Cross and Strand Co. for the construction of a distributing station in Beech Street, and by the London Electric Supply Corporation for additions to the boiler house at Deptford.

A L.C.C. Steel Contract.—The L.C.C. Bridges Committee recommended that in a specification for certain steel work for the new Vauxhall Bridge, a clause should be inserted declaring that all materials should be of British manufacture only. It has over and over again been proved that the Council's attitude in taxing the British manufacturer with labour clauses which it cannot impose upon the foreigner is both illogical and unfair. But unhappily the recommendation of the Committee was referred back at Tuesday's meeting of the Council by a majority of 5, the voting being 49 to 44. Some of the speakers fancied they smelt a "Protection" rat, but it was pointed out that it was desirable that the steel should be manufactured in England, so that the engineer could give it proper supervision.

Appointments Vacant.—Assistant electrical engineer for Torquay (£156); electrical engineer for Aldershot (£200, rising to £260); engineer for the North-Western Fever Hospital (50s. and all found); teacher of electric lighting and wiring, for one evening per week, for Finchley; an instructor in electric wiring and house-fitting, for evening classes, also a student demonstrator in physics and chemistry, are required for the Battersea Polytechnic; electric lighting engineer for Port Elizabeth (£600, rising to £750); senior and junior engineer-in-charge for the Shanghai generating station (£280 and £245 respectively). See "Official Notices" to-day.

Conversazione of the Institution of Electrical Engineers.—This always enjoyable function took place on Tuesday evening last, and was well attended, the total number present being nearly 1,600. It would be impossible to find a more delightful place for the function than the Natural History Museum, which was brilliantly lighted with Bremer arc lamps for the occasion; the string band of the Royal Engineers, conducted by Lieut. J. Sommer, M.V.O., performed a lengthy programme in the central hall, and the Leoni Ladies' Quintette fulfilled a similar office in the Bird Gallery in the west wing, which was thrown open on this occasion.

The guests were received by the President, Mr. R. Kaye Gray, and Miss Gray, and the Council of the Institution; amongst those present were Lord Kelvin, Sir J. Wolfe Barry, Sir E. H. Carbutt, Sir Henry Mance, Sir John D. Pender, Sir W. H. Preece, General Sir T. Fraser, Major-General C. E. Webber, Colonel R. E. Crompton, Profs. Grylls Adams, Ayrton, Kennedy and Thompson, and Messrs. Callender, Ferranti, Gripper, Hammond, Kingsbury, McMillan (secretary), Mordey, Patchell, Rider, Siemens, Swan, Swinburne, Swinton, and many other eminent and distinguished men of science and engineering. The function passed off without a hitch, and was heartily enjoyed by all who took part in it.

Nernst Lamps.—From the Electrical Company, Ltd., a report comes to hand on some tests on alternating-current Nernst lamps, carried out by Mr. J. E. Edgcombe, borough electrical engineer, Kingston-on-Thames:—Six A-type 1-ampere lamps averaged 400 hours in one case, and 585 hours in another, while three ½-ampere B-type lamps averaged 738 hours, the lamps being switched on and off for a period of one hour daily. From these tests it would appear that equally favourable results are obtainable with either alternating or continuous current lamps.

Wireless Telegraphy.—A press message from Glace Bay (June 22nd) reports that "Signor Marconi's manager has announced that the company is transmitting daily wireless messages from Table Head to Poldhu, but the replies are being cabled pending the installation of machinery at Cornwall."

The *Pall Mall Gazette* of Wednesday says:—"After further experimental trials, the Commonwealth telegraph authorities have pronounced against the adoption of the Marconi system of wireless telegraphy. Mr. R. T. Scott, the official head of the Australian Postal and Telegraph Department, personally supervised the trials on the coast of Queensland. In a statement made on his return to Melbourne, he declared that he was not favourably impressed with the system for purposes of practical telegraphy. The currents could not be controlled, and the messages might be stolen by anybody who cared to erect a Marconi apparatus."

Change of Address.—Messrs. Ernest Scott & Mountain, Ltd., have removed their London branch office to Norfolk House, Laurence Pountney Hill, E.C.

Lecture.—At Birmingham on 16th inst., before the Technical School Metallurgical Society, Mr. J. H. Stansbie gave a lecture on "Electrical Resistance."

THE CENTRAL STATION ENGINEER.

The staff connected with the Electricity Department of the St. Pancras Borough Council journeyed to St. Albans on Saturday, June 13th, by brakes. The weather was not at all favourable, but the party, numbering about 90, made the best of the prevailing circumstances. Upon arrival at St. Albans they repaired to the Abbey Institute, where the ninth annual dinner was served. The Mayor of St. Pancras presided, with Mr. S. W. Baynes in the vice-chair. It was intended to hold sports in the afternoon, but owing to the bad weather, this item was abandoned.

Hastings T.C., on Friday, adopted a recommendation from the Electricity Committee to the effect that six months' notice be given Mr. Leonard Andrews, the consulting electrical engineer, of the desire of the Council to determine his appointment on December 25th next.

Mr. R. A. Cunningham has resigned his appointment as engineer-in-charge at the Bath Electricity Works for the purpose of commencing business in company with Mr. J. MacFadyen, the station superintendent at the Paisley Corporation Electricity Works. The firm will carry on business in Paisley as MacFadyen & Cunningham, and for the present they will devote their attention principally to mechanical engineering.

The staff of the Isle of Wight Electric Light and Power Co., numbering nearly 50, from Ventnor, Sandown, Shanklin, Newport and Cowes, took their summer outing on Saturday, 20th inst., arriving in coaches at Ryde for dinner at the York Hotel. In a short address the engineer and manager, Mr. A. E. Mayes, stated that the success of the company was due in a large measure to the wiremen, who always did their best to meet consumers' wishes, and that in Ventnor 40 per cent. of the householders had electric light which, he thought, was almost a record for the United Kingdom.

NEW COMPANIES REGISTERED.

British Electric Signs Co., Ltd. (77,689).—This company was registered on June 13th, with a capital of £20,000 in £1 shares (12,000 preferred ord.), to adopt an agreement with Frank W. Smith and Mrs. Florence W. Smith, and to carry on the business of advertisers, advertising agents and contractors, manufacturers of and dealers in electric and other advertising signs and devices, electricians, engineers, suppliers of electricity for advertising, light, heat, motive power or otherwise, &c. The first subscribers (each with one pref. ord. share) are:—F. G. Nash, 119, Hydethorpe Road, Balham, S.W., gent.; F. J. Aldersley, 4, The Terrace, Leatherhead, gent.: A. A. Sloggett, 66, Manor Park Road, Harlesden, N.W., gent.; A. V. Elliott, 54, Belle Vue Road, New Southgate, N., gent.; J. E. Osborne, 63, Sulgrave Road, Shepherd's Bush, W., clerk; W. B. Wilmot, 32, Rotherhithe Street, Rotherhithe, S.E., clerk; and G. Gulliver, 14, Great Winchester Street, E.C., gent. No initial public issue. The number of directors is not to be less than two nor more than five: the subscribers are to appoint the first; remuneration, £100 each per annum.

ELECTRICITY SUPPLY ACCOUNTS.

Leigh Municipal Electrical Supply.

The returns of the electrical department of this borough for the year ending March, 1903, show satisfactory progress over the preceding year. The units sold have increased by 129 per cent. over 1901-2, and what is indirectly, perhaps, of more importance, the power units are four times greater than in last year, and the load factor reached 14·9 as compared with 12·31 in 1901-2. The improved conditions of generating have contributed to a reduction of works costs by ¼d. per unit, notwithstanding the inclusion of two extra items, *i.e.*, £124 for water, and £37 for use of boilers paid to the gas department.

The prices charged by the department are: for private lighting, 7d. and 2½d. per unit on the demand indicator system, or a flat rate of 5d. per unit less 10 per cent; power, 3d. to ⅝d. per unit.

Recognising the value of large power consumers in bringing down the costs, it is proposed to allow preferential discounts according to consumption, varying from 15 per cent. on 10,000 to 25,000 units to 33 per cent. for over 125,000 units per annum. Mr. D. M. Kinghorn is the engineer and manager.

General Statement.

For year ending March 31st—		1902.	1903.	Inc.
Total capital expended		£17,373	£22,271	£4,898
Number of units sold		151,048	344,880	193,832
Equivalent number of 8-c.p. lamps		15,853	18,166	2,313
Number of public lamps		1	1	—
No. and h.p. of motors		52 motors	75 motors =533 h.p.	23 motors
Maximum load in kw.		140	264	124
Revenue Account. Gross revenue		£2,060	£3,617	£1,557
Gross expenditure		£980	£1,890	£910
Gross profit		£1,074	£1,721	£647
Average price per unit sold		3·16d.	2·41d.	—·75d.

Revenue Account.

	1901-2. Gross.	Per unit.	1902-3. Gross.	Per unit.	Inc.
By sale of energy	£1,990	3·16d.	£3,467	2·41d.	—·75d.
Motor & meter rents	70	·11d.	150	·11d.	—·00d.
Gross revenue	£2,060	3·27d.	£3,617	2·52d.	—·75d.

Working Expenses.

	1901-2. Gross.	Per unit.	1902-3. Gross.	Per unit.	Inc.
Coal, &c.	£221	·36d.	£548	·38d.	·02d.
For use of boilers of gas department	—	—	37	·03d.	·03d.
Oil, waste, water and engine-room stores	82	·13d.	150	·10d.	—·03d.
Wages	266	·42d.	437	·30d.	—·12d.
Repairs and maintenance of buildings, machinery and plant	66	·10d.	359	·25d.	·15d.
Works and distribution costs	£635	1·01d.	£1,526	1·06d.	·05d.
Rents, rates and taxes	130	·20d.	117	·08d.	—·12d.
Management expenses, salaries of engineer, secretary and clerical staff, stationery, printing, law insurance and general establishment charges, &c.	221	·35d.	253	·17d.	—·18d.
Total costs	£986	1·56d.	£1,896	1·31d.	—·25d.

Profit Statement.

	1901-2.	1902-3.
Interest and sinking fund	£829	£1,169
Instalment on motors and special charges	164	288
Balance carried forward	81	264
Gross profit	£1,074	£1,721

During the year the department has earned a gross profit of £1,721, and after meeting interest on loans £635, sinking fund £534 and other charges, a balance of £264 remains, as compared with £81 in the previous year.

CITY NOTES.

The West African Telegraph Co., Ltd.

The eighteenth ordinary general meeting of the shareholders of this company was held on Thursday of last week at Electra House, E.C., the Marquis of Tweeddale presiding.

The Chairman, in proposing the adoption of the report, said that when they had the pleasure of meeting the shareholders early in July last year, they were able to announce that the negotiations with the French Government for the sale of a portion of their system and the settlement of all their outstanding differences had been successfully concluded. It was also foreshadowed that the financial position of the company would thereby be essentially improved. Now that they had had an opportunity of studying the accounts, he believed the shareholders would consider that the forecast then made had been amply fulfilled. It was a great satisfaction to the directors, and he was sure it was also a pleasure to the shareholders to know that the company, which formed one of the groups of associated companies, was now in the position to pay a dividend. He trusted that condition would be a permanent one, and that the company would take its place amongst the other successful associated undertakings. Owing to the new conditions of working, in consequence of the arrangements he had just referred to, it would be impracticable to make the customary comparison of working expenses, but there were one or two matters in the accounts to which he would like to call their attention. They would no doubt remember that one of the conditions of the agreement between the French Government and the company was the cancellation of the outstanding subsidies which had been withheld by that Government. Although the amount due from them on subsidy account had from time to time been brought into the revenue account, they had taken the precaution to create out of reserve a special reserve fund equal to the amount unpaid, so that that debt and the special reserve fund *per contra* both disappeared from the accounts. In consideration of the sale to the French Government of the cables serving the French stations—Conakry, Grand Bassam, Kotouon and Libreville—the Government paid them in cash £144,000 in accordance with the agreement of February 10th, 1902. In addition to that cash payment, the French Government agreed to forego the payment of their claim of £20,000, mutually agreed to be due to them. Inasmuch, therefore, as that sum was taken into account in fixing the price to be paid for the cables, the actual purchase price for the cables transferred was £164,000, which had been applied in a reduction of the capital account. The debenture sinking fund which had been created, and which up to September 18th, 1901, amounted to £160,700, had likewise been applied in a reduction of capital expenditure, and now the capital and capital expenditure accounts exactly balanced each other. As compared with last year, the gross revenue showed a decrease of £5,155, but it must be remembered that the French subsidy of £12,000 had disappeared from the accounts, and, therefore, the directors regarded the return as a very satisfactory one. The expenses attending the repair of cables amounted only to £8,684 as against £17,721 last year—a decrease of £9,037. They had thus been able to carry a much needed contribution of £20,000 to the general reserve fund, which now amounted to £73,821, of which £48,435 was invested. Since the date of the accounts they had been able to invest a further sum of £10,655, and they looked forward to being able to gradually fully invest the fund, now that they had squared their capital and capital expenditure accounts. In case any shareholders might think that the dividend of 2 per cent. which the directors proposed to pay was, under the circumstances, rather small, he would like to make one or two explanatory remarks. Doubtless they could have paid a higher dividend, but only at the expense of the general reserve fund. The directors were of opinion that that fund was at present inadequate, taking into account the age of the cables, now about 18 years, and they therefore considered that the fund should be built up whenever the opportunity offered. It must also be borne in mind that the Portuguese guarantee arrangements terminated in about seven years. There was also another contingency to be provided for, which was that, under the agreement with the French Government, they had to maintain the cables for two years. He could not say, definitely, that a larger dividend would be paid next year, but, so far as they could judge at present, there was every likelihood of their being able to do so.

Sir Henry C. Mance seconded the motion, and the report was adopted.

Electric and General Investment Co.—The directors recommend the following dividends, &c., for the year ended May 31st, 1903:—

Ordinary Shares.—A dividend of 5s. per share, of which 2s. per share was paid on account in December last, leaving 3s. per share to be distributed, and a bonus of 2s. per share. The trustees of the ordinary shares reserve fund propose to distribute 6d. per share, making a total present distribution of 5s. 6d. per share or 27½ per cent., or a total distribution of 7s. 6d. per share, or 37½ per cent. for the year.

Founders' Shares.—A dividend for the year ended May 31st, 1903, of £50 per share. The trustees for the founders' shares reserve fund propose to distribute £5 per share, making a total present distribution of £55 per share.

Prospectuses.

An issue of £100,000 first mortgage 5 per cent. bonds has been offered to the public this week by La Capital Traction and Electric Co., Buenos Aires, Ltd., on behalf of the Cordoba Light and Power Co.

The list was to close on Wednesday in an issue of 185,984 5 per cent. cumulative preference shares of £1 each in the Metropolitan Electric Tramways, Ltd., offered by the Electric and General Investment Co. The dividend is guaranteed by the B.E.T. Co. until December 31st, 1904. The objects of the Metropolitan Co. and its schemes for North London are pretty well known to our readers.

The list opens to-morrow and closes on 30th inst. in an issue of 20,000 6 per cent. cumulative preference shares of £5 each, and 3,000 ordinary (£5) at par, in Messrs. D. Bruce Peebles & Co, Ltd. The nominal capital is £200,000, divided equally into preference and ordinary shares.

Oriental Telephone and Electric Co.

An extraordinary general meeting was held on 17th inst. at the Cannon Street Hotel, Sir A. Colvin in the chair, to consider resolutions—(1) for increasing the capital of the company by the issue of 100,000 new preference shares of £1 each, and (2) for making certain alterations and additions to the articles of association. The money, it was explained, is needed in connection with telephone work which has to be carried out under the new licenses, and for providing more working capital for their electrical branches, which, with judicious outlay, should prove increasingly remunerative.

The resolutions were agreed to.

New General Traction Co.

The report for the year ended March 23rd last, to be presented at the meeting on 2nd prox., shows gross profits for the year £11,585, after charging the sum of £5,714 for general expenses, salaries, directors' fees, interest on loans and legal expenses. After deducting £9,064, being 5 per cent. interest on the company's outstanding mortgage debentures up to March 23rd last, there remained a balance of £2,521. To that balance has to be added the sum of £11,662 brought forward from last year, making a total amount of £14,183 standing to credit of profit and loss account. The directors recommend that this should be carried forward. The disappointing results of the past year are attributed to the prolonged delay in completing the tramways belonging to the Philadelphia, Morton and Swarthmore Street Railways Co., of which this company holds the securities; and the bad weather during the spring and summer of 1902, which seriously affected the earnings of all the company's English tramways.

Waygood & Otis.

Mr. Henry C. Walker presided at the meeting of this company, held at Cannon Street Hotel on 17th inst. In spite of the dislocation of business consequent upon the reorganisation resulting from the purchase of the Otis Elevator Co., there was a substantial advance in the profit and loss balance (£68,858). There was a net balance of £15,711, of which £2,776 had been paid in interim dividend, and a further dividend at the rate of 13 per cent. per annum for the six months ended March, 1903, would make 9 per cent. on the ordinary shares, and leave £4,949 to be carried forward. The chairman referred to the large amount of lift work in hand and in prospect.

Mr. R. P. Sellon seconded the motion, and said that he thought the result before them justified the anticipations of those who advocated the amalgamation.

The report was unanimously adopted and the dividend resolutions passed; the retiring directors and auditors were re-elected.

United River Plate Telephone Co.

The report for the year ended March 31st last, to be presented at the meeting on 2nd prox., states that gross receipts in sterling for the year in the River Plate were £124,470, as against £114,841 for the year before, and the working expenses in London and the River Plate £68,661. Deducting debenture interest and interim dividends on preference and ordinary shares, and adding interest on investments and transfer fees, there remains a profit of £28 898, to which must be added £6,414 brought forward from the previous year, leaving an available balance of £35,313. After transferring the sum of £20,000 to reserve fund, which will then amount to £95,000, the directors recommend that a final dividend of 4 per cent. be paid upon the ordinary shares, making, with the interim dividend paid December 31st last, a return of 7 per cent. for the year, and that the balance of £3,713 be carried forward.

Eastern Extension, Australasia and China Telegraph Co.—The company has declared an interim dividend for the quarter ended March 31st last of 2s. 6d. per share.

STOCKS AND SHARES.

Wednesday Evening.

While there is decidedly more tone than business in the markets of Capel Court, it is at least satisfactory to remark that the tone, so far as electrical departments are concerned, keeps steadily good. The reduction in the Bank Rate to 3 per cent. has released a slight portion of the money which the public was keeping on deposit with the banks: it is better to get a safe 3½ per cent. on some first-class electrical supply debenture stock than it is to receive 1½ per cent. from one's bankers on a deposit account. The movement, however, has scarcely made much way at present, but the mere fact of its being noticeable is something for which the Stock Exchange, and therefore the investor, must be grateful. Needless to say, the optimists are now fixing all their hopes upon the autumn as the time when a revival in business may be expected.

In the Electricity Supply section, a trio of Debenture stocks have each hardened a point, although the City of London 5 per cent. scrip has but regained its loss of a week ago. The shares are also better, following the same course, but Metropolitans fell ½, marked *ex* the right to apply for the new shares, which, of course, meant practically nothing, so far as profit went. A few sales have taken place in connection with the decision as to the powers sought by the Marylebone authorities for paying the Metropolitan Co. the money due to the latter. Notting Hill shares are down ½; the company's 4 per cent. First Mortgage Debentures keep dull at a shade over par. Of these Debentures there is now outstanding an amount of £50,000, part of which was issued at 106, another part at 107½ (in May, 1898), while the last lot produced £100 13s. The stock is well secured, and is not redeemable at par until 1931, unless the company should choose to pay it off, in July, 1907, at 105. Naturally the market in the Debentures is a limited one; but these brief particulars suffice to show the attraction of the stock as an investment. The Electric and General Investment Trust has declared a dividend and bonus, making 37½ per cent. for the year, and £55 per founder's share.

Mention of redemption leads to an expression of astonishment at the extraordinary prospectus sent out in regard to the new South Wales Electrical Power Debenture issue. No word as to the dates of interest payment or of the redemption was to be found, and the market promptly refused to quote even a nominal price in a stock as to which some of the most essential particulars were not given. Subsequently it transpired that the stock is to be a perpetual Debenture, and the quotation is called about 2 per cent. premium.

Another issue that appeals to a much wider circle is the Preference capital offered by the Metropolitan Electric Tramways Co. In this case, the extensive character of the enterprise and the uncertainty attaching to its ramifications give an air of unwonted speculation to these Preference shares. It was stated in the course of Stock Exchange gossip that Mr. Garcke had declared the company to be one of the best with which he had been associated, and a pre-allotment premium became established on the shares. Of course the prosperity of the undertaking lies greatly in the future, but the shares appeal to a certain class of investors, although they are of little use as a medium for "stagging."

Greater strength is manifested in the telegraph market, the Eastern group being to the front with several rises. Eastern Ordinary is 2 up and "Chinas" are ½ better, the prior stocks hardening as well. Herein may be seen an illustration of the public's return to the investment departments. Submarine Cables Trust Certificates, on New York demand, have risen 3, but Globes remain as they were. Anglo-American Preferred is another point to the good, and so is Commercial Cable Debenture stock. Of the Western descriptions, an improvement of a point has taken Western Telegraph 4 per cent. to a shade under par. Marconi shares are 2⅛ middle. Nothing fresh has occurred in the National Telephone issues, but Orientals slipped back $\frac{1}{16}$ to 17s. 6d.

British Electric Traction Ordinary are down ¼, despite the expectation of a favourable report, and amongst other miscellaneous shares, India-Rubber are down 10s. upon the very cautious tone adopted by the chairman at the meeting. Callender's have not changed, but Henley's fell £1 as half-a-dozen selling orders came upon a market destitute of buyers. The Debenture stock, however, has risen a point.

In the Railway department, Central London Ordinary Preferred and Deferred have all dropped 1 per cent., upon what ground it is difficult to say, unless one falls back on the supposition that the coming electrification of the District may have some dim connection with the movement in Twopenny Tube stocks. It is significant to notice that London General Omnibus stock is still advancing, and has now reached 105. London United Tramways Preference are being done over 12, and the Debenture stock at 107. Calcutta Trams change hands about 7, and Anglo-Argentines in the vicinity of 4½. North Metropolitan Tramways have come into attention on the new Metropolitan Electric prospectus, and the price is 3½. A few New General Traction Preference were sold at 2⅜ on Tuesday last.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1900.	1901.	1902.	Closing Quotations June 17th.	Closing Quotations June 24th.	Business done week ended June 24th, 1903. Highest	Lowest
67,100	African Direct Telegraph, 4 % Debs.	100	..	..	..	98 —102	98 —102	101	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	..	..	..	2⅜ — 3⅛	2⅜ — 3⅛	..	..
119,700£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	..	..	..	70 — 80	70 — 80	..	..
788,840	Anglo-American Telegraph	Stock	3½%	6l5.	60/6	46 — 49	46 — 49	47	46
3,105,580	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	90 — 92	91 — 93	92⅜	91½
3,105,580	Do. do. do. Deferred	Stock	5s. %	2s.	1/-	8 — 8⅛	8 — 8⅛	8 1/16	..
44,000	Chili Telephone, Nos. 1 to 44,000	5	5 %	5 %	..	4⅜ — 5⅛	4⅜ — 5⅛	..	..
13,333,300$	Commercial Cable	$100	8 %	8 %	8 %	155 —165	155 —165	..	..
1,841,200	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	..	..	..	89 — 92	90 — 93	92⅛	91½
16,000	Cuba Telegraph	10	4½%	4 %	6½%	6⅛ — 7⅛	6⅛ — 7⅛	7⅛	..
6,000	Do. 10 % Pref.	10	..	..	..	15 — 16	15 — 16	..	..
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	2⅛ — 3⅛	2⅛ — 3⅛	..	..
6,000	Do. do. 10 % Cum. Pref.	5	..	..	..	7 — 8	7 — 8	..	..
30,000	Do. do. 4½ % Debs.	50	..	..	..	98 —102	98 —102	..	..
60,710£	Direct United States Cable	20	3½%	3½%	..	9 — 10	9 — 10	9⅛	9 3/16
92,800£	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,200, Red.	100	..	..	..	99 —102	99 —102	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	..	119 —124	121 —126	124½	121
1,955,565	Do. 3½ % Pref. Stock	100	..	..	..	83 — 86	85 — 88	87½	86½
1,534,645	Do. 4 % Mort. Deb. Stock Red.	Stock	..	..	..	104 —107	104 —107	106½	105½
300,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	10½ — 11½	10½ — 11½	11 1/16	11⅛
320,000£	Do. 4 % Deb. Stock	Stock	..	..	..	105 —108	105 —108	..	..
300,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 3,000, red. 1909	100	..	..	..	99 —102	99 —102	100½	100⅛
200,000£	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	..	..	..	101 —104 %	99 —102	..	..
180,227	Globe Telegraph and Trust	10	5½%	5½%	..	8⅛ — 8⅝	8⅛ — 8⅝	8⅝	8⅛
180,042	Do. do. 6 % Pref.	10	..	..	..	11½ — 12½	11½ — 12½	12⅛	11⅝
150,000	Great Northern Telegraph, of Copenhagen	10	15 %	15 %	12½%	22 — 24	22 — 24	23½	22½
66,800£	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	..	..	..	99 —102	99 —102	..	..
17,000	Indo-European Telegraph	25	10 %	10 %	10%	36 — 40	35 — 39	..	..
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	..	..	..	100 —104	100 —104	..	..
1,983,333	National Telephone, Pref. Stock	100	5 %	5 %	6 %	101 —103	101 —103	102⅞	100
1,966,667	Do. do. Def. Stock	100	..	..	4½%	80 — 83	80 — 83	82	80
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12 — 13	12 — 13	12⅝	12½
2,250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	5 %	5 — 5⅛	5 — 5⅛	5 1/16	5⅛
000,000£	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	98 —100	98 —100	98	..
600,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	103 —105	103 —105	104	103⅝
171,504	Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid	1	6 %	6 %	6 %	⅞ — 1	15/16 — 1⅛	..	..
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	..	..	..	97 —100	97 —100	..	..
11,839	Reuter's	8	5 %	5 %	..	6½ — 7⅛ xd	6½ — 7⅛	..	..
3,308	Submarine Cables Trust	Cert.	..	..	..	104 —112	101 —109	112	..
58,000	United River Plate Telephone	5	7 %	7 %	7 %	5⅛ — 6	5⅛ — 6	5⅛	..
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	..	..	..	4⅞ — 5⅛	4⅞ — 5⅛	..	..
179,947£	Do. do. 5 % Debs.	Stock	..	..	..	105 —108	105 —108	..	..
15,609	West African Telegraph, Shares	10	..	..	2 %	4 — 5	4 — 5	..	..
150,000£	West Coast of America, 4% Debs., 1 to 1,500 guar. by Bras. Sub. Tel.	100	..	..	..	92 — 97	92 — 97	..	..
267,980	Western Telegraph, Ltd., Nos. 1 to 207,980	10	7 %	7 %	..	11 — 12	11 — 12	11 5/16	11 1/16
75,000£	Do. do. 5 % Debs. 2nd series, 1906	100	..	..	..	101 —104	101 —104	..	..
400,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	96 — 99	97 —100	99½	..
88,821	West India and Panama Telegraph	10	½%	..	..	⅜ — ½	⅜ — ½	..	..
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	..	..	..	6 — 6½	6 — 6½	..	..
4,609	Do. do. do. 6 % Cum. 2nd Pref.	10	..	..	..	3 — 4	3 — 4	3½	3⅜
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	..	..	..	99 —102	99 —102	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

20,000	British Aluminium 7 % Cum. Pref.	10	..	..	..	3 — 4	3 — 4	..	..
800,000£	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	..	..	..	74 — 79	74 — 79	..	..
100,000	British Electric Traction	10	9 %	9 %	..	14 — 14½	13⅞ — 14½	14⅞	13⅞
100,000	Do. do. 6 % Cum. Pref.	10	..	..	..	12 — 12⅝	12 — 12⅝	12⅝	12⅜
600,000£	Do. do. 5 % Perpetual Debenture Stock	Stock	..	..	..	122 —125	122 —125	124½	123½
100,000	British Insulated and Helsby Cables	5	15 %	10 %	10 %	6⅜ — 7⅛	6⅜ — 7⅛	6⅝	..
100,000	Do. do. 6 % Cum. Pref.	5	..	..	..	5⅝ — 6	5⅝ — 6	..	..
50,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	..	..	..	103 —107	103 —107	106	105½
50,000	¶Browett, Lindley & Co., Ord.	£1	8 %	Nil	..	13/16 — 1 1/16	13/16 — 1 1/16	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	6 %	6 %	..	14/6 to 15/6	14/6 to 15/6	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731	2	5 %	Nil	Nil	1⅜ — 1½	1⅜ — 1½	..	..
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	3 %	6 %	1½ — 1⅝	1½ — 1⅝	..	..
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	..	..	..	99 —102	99 —102	99	..
125,000£	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	..	..	..	89 — 94	89 — 94	..	..
35,000	Callender's Cable Construction shares	5	15 %	20 %	15 %	12 — 13 xd	12 — 13	..	..
40,000	Do. do. do. 5 % Cum. Pref.	5	..	..	..	5⅛ — 6	5⅛ — 6	..	..
90,000£	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	..	..	..	108 —112	108 —112	..	..
1,860,014	Central London Railway, Ord. Stock	Stock	..	4 %	4 %	105 —108	104 —107	106½	105½
494,098	Do. do. 4 % Pref. Stock	Stock	..	4 %	4 %	102 —105	101 —104	103½	102½
494,998	Do. do. Def. do.	Stock	..	4 %	4 %	108 —111	107 —110	109½	..
1,330,000	City and South London Railway	Stock	1½%	2 %	3½%	70 — 72	71 — 73	71	70
85,000	Crompton & Co., Nos. 1 to 85,000	5	8 %	7½%	..	2 — 2½	2 — 2½	..	..
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red.	..	..	..	..	102 —106	102 —106	..	..
99,261	Edison & Swan United Elec. Light, "A" shares, £8 paid, 1 to 99,261	5	2½%	Nil	..	0 — ¼	0 — ¼	..	..
17,139	Do. do. "A" shares, 01—017,139	5	2½%	Nil	..	1⅛ — 2⅜	1⅛ — 2⅜	..	..
344,023£	Do. do. 4 % Deb. Stock Red.	100	..	..	..	73 — 77	73 — 77	..	..
100,000£	Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	..	..	..	75 — 80	75 — 80	..	..
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	..	1⅝ — 2	1⅝ — 2	..	..
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	..	..	..	2⅛ — 3	2⅛ — 3	..	..
82,500£	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	..	..	..	100 —103	100 —103	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	..	9⅜ — 10⅛	9⅜ — 10⅛	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	..	..	..	99 —102	99 —102	..	..
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	20 %	20 %	20 %	15 — 16	14 — 16	15	14⅜
35,000	Do. do. 4½ % Pref.	5	4½%	..	..	5 — 5⅛	5 — 5⅛	..	..
48,050	Do. do. 4½ Mort. Deb. Stock	Stock	..	..	..	107 —111	107 —111	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10 %	..	19 — 20	18⅜ — 19⅝	19	..
800,000£	Do. do. 4 % 1st Mort. Deb.	100	..	..	..	100 —103	100 —103	..	..
37,500	†Liverpool Overhead Railway, Ord.	† 10	3½%	1½%	1½%	5⅞ — 6	5⅞ — 6	..	..
10,000	† Do. do. Pref. £10 paid	† 10	..	..	..	10½ — 11	10⅝ — 10⅞	..	..
37,350	Telegraph Construction and Maintenance	12	17½%	20 %	20 %	33 — 36	32 — 35	33	..
150,000£	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	..	..	..	101 —104	101 —104	..	..
640,000£	Waterloo & City Railway, Ord. Stock	100	3 %	3 %	3½%	98 —101	99 —102	..	..

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

National Electric Free Wiring, 3—6.

Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 14½—14⅝.
Do. do. Pref (£10 pd.), 10—10⅛.

Bank rate of discount 3 per cent. (June 18th, 1903).

SHARE LIST OF ELECTRICAL COMPANIES (*continued*).—ELECTRICITY SUPPLY COMPANIES.

Present issue.	NAME.	Stock or Share.	Dividends for the last three years. 1900.	1901.	1902.	Closing Quotations June 17th.	Closing Quotations June 24th.	Business done week ended June 24th, 1903. Highest.	Lowest.
		‡							
100,000	Blackheath and Greenwich Dist. Electric Light, Ord...	1	..	..	..	3/8 — 7/8	3/8 — 7/8	..	..
100,000	Do. 4½% 1st Deb. Stock, Prov. Certs. ..	100	..	..	..	118 —121	118 —121	..	..
20,000	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 ..	5	6 %	8 %	8 %	10¼— 11	10¼— 11	..	..
20,000	Do. do. 7 % Cum. Pref. ..	5	..	..	..	10¼— 10⅜	10¼— 10⅜	..	..
50,000	Charing Cross and Strand Electricity Supply	5	9 %	10 %	10 %	9 — 9⅛	9 — 9⅛	9⅛	..
70,000	Do. do. do. 4½% Cum. Pref. ..	5	..	..	..	5¼— 6	5¼— 6	..	..
40,000	Do. do. "City Undertaking" 4½% Cum. Pref. ..	5	..	..	..	4⅜— 5¼	4⅜— 5¼	..	..
250,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	104 —105 xd	104 —106	105	..
44,436	*Chelsea Electricity Supply, Ord.	5	5½%	4 %	4½%	6 — 6¼	6 — 6¼	6¼	..
150,000‡	Do. do. % Deb. Stock Red.	Stock	..	..	..	107 —110 xd	107 —110	..	..
70,595	City of London Electric Lighting, Ord. 40,001—110,595	10	0 %	5 %	5 %	11¼— 12⅜	11¼— 12⅜	11⅜	11⅛
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	..	..	13 — 14	13 — 14	..	..
400,000‡	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid ..	..	..	..	..	122 —127	123 —128	127	126½
800,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	..	..	..	104 —107	104 —107	106	..
40,000	County of London & Brush Prov. Electric Lighting, Ord. 1—40,000..	10	4 %	4 %	4 %	8 — 9	8 — 9	..	..
20,000	Do. do. 6 % Pref., 40,001—60,000..	10	..	..	..	12 — 13	12 — 13	12⅜	..
400,000‡	Do. do. 4½% Deb. Stock, Prov. Certs. (all paid) Red ..	..	..	..	..	111 —114	111 —114	112½	..
50,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	..	6¾— 7	6¾— 7	..	..
30,000	Do. do. 6 % Cum. Pref.	..	..	..	..	6 — 6¼	6 — 6¼	6¼	6¼
140,000	Do. do. 4½% 1st Mort. Deb. Stock ..	100	..	..	..	107 —110	108 —111	109½	..
21,000	Kensington and Knightsbridge Electric, Ord.	5	12 %	10 %	10 %	11 — 12	11 — 12	..	..
90,000	Do. do. do. 4 % Debenture Stock ..	Stock	..	..	..	108 —106	103 —106	..	..
110,000	London Electric Supply Corporation, Limited, Ord.	3	..	..	..	2⅛— 2⅜	2 — 2⅛	..	..
49,840	Do. do. do. 6 % Pref.	5	..	..	..	5¼— 6	5¼— 6	..	..
250,000‡	Do. do. do. 4 % 1st Mort. Deb. Stock Red	Stock	..	..	..	99 —101 xd	100 —102	..	..
100,000	Metropolitan Electric Supply, 1 to 100,000	10	6 %	6⅔%	7⅓%	17⅛— 18⅛	17 — 18	18⅛	17⅞
220,000‡	Do. do. 4½% 1st Mort. Deb. Stock	..	..	..	..	110 —115	110 —115	..	..
250,000‡	Do. do. 3½% Mort. Deb. Stock Red	Stock	..	..	..	98 —101	98 —101	100	..
10,852	Notting Hill Electric Lighting	10	7 %	6 %	6 %	14 — 15	13⅛— 14⅜	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14⅓%	14⅓%	14⅓%	15¼— 16⅛	15¼— 16⅛	16⅛	16
20,000	Do. do. do. 7 % Pref. 20,081 to 40,080	5	..	..	..	8¾— 9⅛	8⅜— 9⅛	..	..
150,000‡	Do. do. do. 3½% Deb. Stock Red ..	100	..	..	..	99 —102	99 —102	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	..	..	2½%	3¾— 4	3 — 3⅜	..	..
65,000	South London Electricity Supply, Ord.	5	..	..	1½%	3¾— 3⅞	3¾— 4	3⅞	..
30,000	Urban Electric Supply, Ord.	5	..	..	..	5 — 5⅛	5 — 5¼	5⅛	..
90,000	Do. do. 5 % Cum. Pref.	5	..	..	..	5 — 5¼	5 — 5¼	..	..
110,000	Westminster Electric Supply, Ord.	5	10½%	10½%	12 %	12 — 13	12 — 13	12¾	..
28,141	Do. do. 5 % Cum. Pref.	5	..	..	..	6⅛— 6⅜	6⅛— 6⅜	6⅜	6⅜

*Subject to Founders Shares. ‡Unless otherwise stated all shares are fully paid.

MARKET QUOTATIONS, Wednesday, June 24th.

CHEMICALS, &c.		Latest Price.	Week's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a ,, Nitric	per cwt.	22/-	..
a ,, Oxalic	per cwt.	32/-	..
a ,, Sulphuric	per cwt.	5/6	..
a Ammoniac, Sal	per cwt.	42/-	..
a Ammonia, Muriate (crystal) ..	per ton	£33 10	..
a ,, ,, ...	per ton	£30	..
a Bleaching powder	per ton	£4 10	..
a Bisulphide of Carbon	per ton	£15	..
a Borax	per ton	£13	..
a Benzole (90 %)	per gal.	7/-	..
a ,, (50/90 %)	per gal.	5/6	..
a Copper Sulphate	per ton	£21	..
a Lead, Nitrate	per ton	£24	..
a ,, White Sugar	per ton	£31	..
a ,, Peroxide	per ton	£27 10	..
a Methylated Spirit	per gal.	2/6	..
a Naphtha, Solvent (90% at 160° C).	per gal.	5/6	..
a Potash, Bichromate, in casks ..	per lb.	3d.	..
a ,, Caustic (75/80%).. ..	per ton	£24	..
a ,, Bisulphate	per ton	£35	..
a Shellac	per cwt.	130/-	3s. inc.
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6 5	..
a ,, Recovered	per ton	£5 10	..
a ,, Lump	per ton	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	..
a ,, Crystals	per ton	£3	..
a ,, Bichromate, casks.. ..	per lb.	2¼d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots ..	per ton	£130	..
b ,, Wire, in ton lots ..	per ton	£168	..
b ,, Sheet, in ton lots ..	per ton	£166	..
p Babbitt's metal ingots	per ton	£43 to £145	..
c Brass (rolled metal 2" to 12") basis	per lb.	7¼d.	..
c ,, Tube (brazed)	per lb.	9d.	..
c ,, ,, (solid drawn).. ..	per lb.	7¾d.	..
c ,, Wire, basis..	per lb.	7¾d.	..
c Copper Tubes (brazed)	per lb.	9d.	¼d. dec.
c ,, ,, (solid drawn) ..	per lb.	9¼d.	¼d. dec.
g Copper Bars (best selected ..	per ton	£75	..

METALS, &c. (*continued*).		Latest Price.	Week's Inc. or Dec.
g Copper Sheet	per ton	£71	£4 dec.
g ,, Rod	per ton	£71	£4 dec.
e ,, (Electrolytic) Bars ..	per ton	£67	£1 dec.
e ,, ,, Sheets ..	per ton	£78	£1 dec.
e ,, ,, Rod ..	per ton	£69	£1 dec.
e ,, ,, H.C. Wire	per lb.	8¼d.	¼d. dec.
f Ebonite Rod	per lb.	8/-	..
f ,, Sheet	per lb.	5/-	..
n German Silver Wire	per lb.	1/6	..
h Gutta-percha fine	per lb.	8/-	..
h India-rubber, Para fine	per lb.	3/9 to 3/10½	dec.
i Iron, Charcoal Sheets	per ton	£18	..
i ,, Pig (Cleveland warrants)	per ton	46/7	4d. inc.
i ,, Forgings, according to size	per ton	From £11	..
i ,, Scrap, heavy	per ton	47/6 to 50/-	..
i ,, Wire, galvanised No. 8 ..	per ton	£9 15	..
g Lead, English Ingot	per ton	£12 5	inc.
g ,, ,, Sheet	per ton	£13 10	..
m Manganin Wire No. 28	per lb.	8/-	..
g Mercury	per bot.	£8 12 6	..
d Mica (in original cases) small ..	per lb.	4d. to 1/2	..
d ,, ,, ,, medium	per lb.	2/3 to 3/6	..
d ,, ,, ,, large ..	per lb.	3/9 to 7/9	..
p Phosphor Bronze, plain castings	per lb.	1/- to 1/2½	..
p ,, rolled bars & rods	per lb.	1/1 to 1/4	..
p ,, ,, strip & sheet	per lb.	From 1/3	..
o Platinum	per oz.	£4	..
p Silicium Bronze Wire	per lb.	10d. to 1/-	..
i Stee., Magnet, acc'd'g to desc'p'n	per ton	£58	..
i ,, ,, in bars		£15 to £40	..
g Tin, Block	per ton	£128 to £129	£3 dec.
g ,, Foil	per lb.	1/8	..
n ,, Wire, Nos. 1 to 16	per lb.	1/7	..
p White Anti-friction Metals— "White Ant" brand ..	per ton	£42 to £65	..
j Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	7¼d.	..
j ,, 6 lea. Flax	per lb.	5¾d.	..
j ,, 3 ply 10 lbs. Russian ..	per lb.	4¼d.	..
j ,, 10 lbs. Russian, single ..	per lb.	4¼d.	..
j ,, 180 lbs. Jute rove ..	per ton	£11	..
k Zinc, Sh't (Vieille Montagne bnd.)	per ton	£24 15	..

Quotations supplied by Messrs.:—*a* G. Boor & Co.; *b* The British Aluminium Co., Ltd.; *c* Thos. Bolton & Sons., Ltd.; *d* F. Wiggins & Sons.; *e* Frederick Smith & Co.; *f* India-Rubber, G.P. and Teleg. Works Co., Ltd.; *g* James & Shakespeare; *h* Edward Tull & Co.; *i* Bolling & Lowe; *j* W. H. Hindley & Co.; *k* Morris Ashby, Ltd.; *m* W. T. Glover & Co., Ltd.; *n* P. Ormiston & Sons *o* Johnson, Matthey & Co., Ltd.; *p* The Phosphor Bronze Co., Ltd.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RECEIPTS.

	Locality.	Week ending	Receipts for the week. £	£*	Total to date. £	£*	Miles open.	*
	Aberdeen	June 20	1,154	+258	3,617	+ 963	—	—
	Birmingham	,, 20	4,732	—281	124,696	+ 6,534	—	—
	Bournemouth	,, 17	866	—	—	—	—	—
	Blackburn	,, 19	737	— 80	10,759	+ 896	12½	+1½
	Blackpool	,, 18	7-2	+121	9,298	+ 1,662	—	—
	Blackpool and Fleetwood	,, 20	652	+182	9,551	+ 1,246	7½	—
	Bolton	,, 21	1,804	+258	22,443	+ 3,743	25	—
	Bradford	,, 14	3,486	+459	40.252	+ 5,846	39	+2
	Brighton	,, 21	869	+ 35	23,958	—	6½	—
	Brussel	,, 19	4,514	+ 56	—	—	28	—
	Burnley	,, 20	699	+ 43	—	—	—	—
British Elec. Trac. Co.	Barnsley District ..	,, 12	166	—	4,085	—	—	—
	Devonport	,, 12	465	+ 52	9,697	+ 283	5	—
	Dudley—Stourbridge..	,, 12	744	+ 79	18.102	+ 1,997	18½	—
	Gateshead	,, 12	834	+ 89	19.370	+ 3,706	10½	+ ¾
	Gravesend—Northfleet	,, 12	223	—	4,819	—	3½	—
	Greenock—Pt. Glasgow	,, 12	772	+108	11,357	+ 1,221	7½	—
	Hartlepool	,, 12	295	+ 45	5,622	+ 695	6½	+2
	Kidderminster	,, 12	121	+ 16	2.704	+ 202	4½	—
	Merthyr	,, 12	200	—	4,442	— 168	3	—
	Middleton	,, 12	571	+828	6,936	+ 677	8½	—
	Oldham—Ashton ..	,, 12	691	+188	13,052	+ 1,514	8	—
	Peterborough	,, 12	184	—	2,925	—	—	—
	Poole	,, 12	314	+ 69	6,298	+ 1,107	3½	—
	Potteries	,, 12	1,455	+ 5	35,793	+ 2,701	28½	—
	Rothesay..	,, 12	183	+ 81	1,786	+ 753	—	—
	Sheerness	,, 10	74	—	883	—	—	—
	Southport	,, 12	498	+182	6,452	+ 1,728	5½	—

	Locality.	Week ending	Receipts for the week. £	£*	Total to date. £	£*	Miles open.	*
B.E.T. Co.	South Staffordshire ..	June 12	850	+136	18,909	+ 1,198	21½	—½
	Swansea	,, 12	503	+ 54	10,957	+ 911	5½	—
	Taunton	,, 12	57	+ 1	1,281	— 80	1½	+½
	Tynemouth	,, 12	380	+ 71	5,990	+ 915	3½	—
	Weston-super-Mare..	,, 10	144	+ 4	1,415	— 116	2½	+½
	Wolverhampton Dist.	,, 12	331	+186	8 852	+ 5,096	10½	+8
	Wrexham	,, 13	146	—	1,512	—	—	—
	Yorks. Woollen Dist. ..	,, 12	320	—	4,450	—	6	—
	Cardiff	,, 20	1,884	+ 308	22,207	+ 9,370	—	—
	Dover	,, 20	220	— 5	4,798	+ 41	8	—
	Dublin	,, 19	4,000	+187	111,136	+ 6,427	46	—
	East Ham	,, 10	596	+146	7,716	+ 2,602	5	+ ½
	Glasgow	,, 6	15,376	+3194	15,376	+ 3,194	65	+15
	Hull	,, 20	1,720	— 7	21,355	+ 1,704	—	—
	Isle of Thanet	,, 20	610	+ 3	9,778	— 391	—	—
	Leeds	,, 20	5,079	+229	66,999	+ 6,036	—	—
	Liverpool	,, 18	10,179	+ 902	232,884	+14,079	101	+5
	Manchester	,, 20	10,871	+5872	—	—	110	+85
	Newcastle	,, 20	3,309	+ 632	—	—	17	—
	Portsmouth	,, 20	1,544	— 29	—	—	29	—
	Salford	,, 15	3,533	+1048	39,074	+12,127	—	—
	Southampton	,, 18	1,187	—231	—	—	—	—
	Sunderland	,, 14	1,146	+ 25	12,795	+ 914	20	+ 2
	Central London Railway	,, 20	6,674	—908	174,526	+ 5,129	6	—
	Chatham & District Co.	,, 18	509	—	11,238	—	8½	—
	City and S. London Ry.	,, 21	2.948	— 69	76,772	+ 2,807	6½	—
	Dublin and Lucan Rlwy.	,, 21	127	+ 16	2,513	+ 81	—	—
	Liverpool Overhead Ry.	,, 21	1,620	+103	39,517	+ 3,719	6½	—

*Compared with the corresponding period of 1902.

THE ENGINEERING CONFERENCE.

Abstract of the Presidential Address Delivered at the Institution of Civil Engineers, June 17th, 1903.

The president, Mr. J. C. Hawkshaw, M.A., in addressing the combined sections, referred to the many striking developments which are taking place, the electrical branch of the profession being mentioned as an instance.

During the last two years the Nile dams for irrigation purposes, and the Coolgardie water-supply have been completed, and during the same time the Engineering Standards Committee, which began its work in April, 1901, as the outcome of a committee appointed by the Institution of Civil Engineers at the suggestion of Sir J. Wolfe Barry, and had been supported by the technical societies and Government, had accomplished work of the highest value to the country at large.

So far only one Committee, that on Building and General Bridge Construction, and one Sub Committee, that on Tramway Rails, have issued the result of their decision, but the conclusions of all are now in an advanced stage. Referring to the questions down for discussion, the education and training of engineers was a subject of great importance, and one of the results of the qualifying examination for admission to the Institution of Civil Engineers had been that many important teaching institutions at home and abroad had already modified their curricula and the standard of their examinations to accord with the Institution practice, and others were preparing to do so. Thus, the work done by the Council had had a stimulating effect on the training of engineers throughout the country.

The education of officers for the navy and for the army is being reorganised. In future, the men who command our ships and fleets must have the same corresponding knowledge of steam, electricity and hydraulics, and the other forces employed in the modern battleship, as they have of the art of navigation, the science of gunnery, or the use of the torpedo. Not only at sea does the Admiralty offer a career to engineers, but also on land in the Admiralty Works Department, appointments to which are made at a much later age than for the sea service. The variety and great importance of the works carried out at our great naval stations at Portsmouth, at Keyham, at Gibraltar and Malta, and elsewhere, should make the opening an attractive one for our younger engineers. (With all due respect to the President, the advantages of being cornered in such a place as Esquimault appear somewhat illusory.)

There would appear to be reasons why the education of civil engineers and of officers for the Navy should be carried out on somewhat the same lines; in both professions, the duties may become highly specialised. What branch was more specialised than that of the electrical engineer, and yet he had to deal with the same problems as the railway engineer in questions of transport and locomotion, as the gas engineer in questions of lighting, as the chemical engineer in questions of the application of electricity to industries, and so on. The engineer who would reach the highest position in his profession should have a knowledge of organisation, of administration and of finance, besides the necessary knowledge of the branch to which he specially devoted himself.

At the beginning of last November he (the president) took occasion to refer at some length to the question of our timber supply. Since then the Committee appointed by the Board of Agriculture to inquire into and report on British forestry had issued its report. Valuable and necessary as some of the recommendations were, the report was, to his mind, disappointing. At present the local authorities distinctly discourage planting by rates and otherwise. In his own county of Sussex a sporting rate was to be imposed, which was a direct tax on planting.

In London many problems remained to be solved. They had yet to grapple with the removal of the solid matter with which we daily pollute the atmosphere of London and the country for many miles round. Sir W. Thistleton Dyer, after a week's fog, found a deposit of tarry matter on the greenhouses at Kew at the rate of six tons to the square mile. Dr. W. N. Shaw, at the Sanitary Congress at Manchester, estimated roughly that it took seven million tons of air a day to carry away the smoke compared with one million tons of water a day required to carry away the sewage. A bad fog might cost £5,000 a day for light alone, and the estimate made of the cost of smoke pollution to London, which put it at as much as five millions a year, was probably below the mark.

Another question which became yearly more pressing in London was that of the means of locomotion and transport. A Royal Commission had been appointed to report as to the measures for the improvement of the same, by the development and inter-connection of railways and tramways, on or below the surface, by increasing facilities for other forms of mechanical locomotion, and further to report as to the desirability of establishing some central authority or tribunal to which all schemes of railway or tramway construction of a local character should be referred, but the terms of reference were very wide, and the Commission's powers would be taxed to find a satisfactory solution. The more facilities were given for travelling locomotion, the more persons they encouraged to travel and take advantage of the better means of transport and locomotion, so that the application of the remedy would tend in some measure to spread the disease. Decentralisation was what was wanted, and if facilities for transport and locomotion encouraged this, it would be a distinct gain to London, especially if it affected factories and workshops, the greatest offenders, with slow and obstructive traffic and smoke pollution. He knew of one firm of manufacturers which had recently removed to the country, and was enabled by doing so to reduce its prices by 20 per cent.

As regards the best means of passenger transport, they had experience of how the advent of railways checked the progress of canals and also of motors, which were far advanced nearly a century ago. "It is to be hoped that tramways will not again check the progress of motors and their use. . . . . Tramlines render roads less suitable or serviceable for all other kinds of traffic. It is well worth considering whether it would not be advisable to make roads suitable for motor traffic of all kinds, and let motors serve public as well as private purposes. Railways afford greater facilities than canals, but motors offer greater facilities than either railways or tramways, and though all three are necessary, nothing should be allowed to check the legitimate development of motor traffic."

It was obvious that the question of making and maintenance of many country roads would have to be considered, and that very soon. One of their members who had the curiosity to count the number of machines passing on the Brighton road near Horley found that in eleven minutes 209 motors and motor or other cycles passed, taking those going in one direction only. Probably few of the persons using them had contributed anything to the making or maintenance of the road.

WIRELESS TELEGRAPHY

By Edmund A. N. Pochin, B.A.

(Abstract.)

Recent developments have aroused much interest, and some very important facts have lately been established.

1. Up to considerable ranges earth-curvature is not a fatal obstacle, but hills may exercise a serious influence.

2. The ether exhibits what we may provisionally call a variable transparency to Hertzian waves, sunlight being an important factor.

With regard to both of these phenomena, it is probable that certain wave-lengths offer special advantages; whilst the second affords a faint clue to the relative share of earth and ether in transmission.

Amongst problems, that of isolation is undoubtedly the most important, and in this direction two methods have been employed which may be termed respectively Syntonic and Optical methods.

Syntonic Methods.—The vertical wire or network commonly used must, of necessity, radiate equally in all horizontal directions, and therefore frequency alone is available as a means of discrimination. At present there is no property in special wave-lengths, and although central control provided by international legislation may do much to prevent interference, messages of this class must always remain open to interception over a large radius by syntonised instruments, or by untuned apparatus at closer quarters. Again, we must not overlook the effect of atmospheric discharges.

In the closed-circuit system with two syntonised coils, one for transmitting and the other for receiving, sharper tuning is practicable; and if the coils are vertical, an element of direction is also secured. This method is unaffected by atmospheric electricity, but is comparatively deficient in range.

Mechanical tuning may be mentioned, involving the use of reeds or tuning forks, in addition to the electrical portions; but it should be noted that sharp tuning at low frequency must imply slow signalling.

No detailed information is available regarding the more recent earth-conduction methods.

Optical Methods.—It is unfortunate that so little attention has been devoted to the use of lenses and reflectors in connection with Hertzian waves for telegraphy. Not only would great privacy result, but we should also be able to give a ship her position. It would be hard to overrate the importance of any system for effecting this reliably, even over so short a range as 10 miles, and with an accuracy as low as 50 per cent. The obstacle which confronts us at the outset is our present inability to radiate a large amount of energy from a small area. So far, a distance of about two miles is credited to their use.

General Remarks.—For the production of wave-trains we still depend on a condenser discharge. The resulting oscillations are no doubt sufficiently sinoidal for the most exacting; but in view of dissipation by brushes and other causes, may not their strict isochronism have been too hastily assumed? Any deviation must be highly prejudicial, as the radiator and receiver would tend in opposite directions. The wide and irregular variation between successive discharges is another difficulty which can be best appreciated by those who have worked with condensers. Alternators have been built with a frequency approaching 30,000 per second, and seem to deserve a reference in this connection.

Wider knowledge will probably tend to reduce that difference of expression and idea which now divides the phenomena of high-frequency from those of low-frequency.

The possibilities arising from the use of two or more radiators in suitable phase-relation to reinforce waves in a particular direction, or from a corresponding arrangement in the receiver, the creation of stationary waves or nodal areas, and the employment of the earth's free period, are amongst speculations which must have occurred to many, over and above any detailed improvements in the proportions or arrangement of apparatus on present lines.

In conclusion, we all hope that developments will be forthcoming to render wireless telegraphy fitted for regular commercial work, in those special departments to which it is so eminently adapted.

Discussion.

In the discussion which followed, Sir William Preece mentioned that he had been working at this subject during the last 50 years

ever since the first experiments by Lindsay at Dundee. This was the first practical paper read on the subject, about which such a large amount of nonsense had been talked. In 1896 Mr. Marconi came to him with his ideas, and he had placed at his disposal all the assistance which the Government and Post Office were able to give, contrary to the general impression created by the numerous unkind remarks which had been made. Since then, but little progress had been made, although we knew more about the ether and air disturbances, and realised that the system of circuitation was applicable. Alternators have been applied with success apparently by De Forest and Tesla in America. He questioned whether they had advanced one step towards a practical solution during the last seven years. As to distances of transmission, if we took the sea as a standard, it was 30 times better than the land; although distances of 10 to 50 miles might be worked for a time, disturbances would be sure to occur, and we had never succeeded in establishing practical transmission overland. In the matter of the speed of signalling, we had reached 5 to 10 words per minute over long distances at sea, and up to 15 words over short distances; in America De Forest was said to have attained 35 words per minute, which was a great advance if true. We could not say that there was one practical wireless telegraph at work in the whole world, although America appeared far ahead of all others at work in this direction.

Mr. Maskelyne emphasised the difficulty of obtaining reliable information on wireless telegraphy. We had received so much enlightenment in the daily press that the whole subject was becoming enshrouded in mystery, it was passing beyond the range of the electrician and inventor, and getting into the hands of the novelist. We must realise that the term wireless telegraphy was a misnomer. We were dealing simply with a disturbance in the atmosphere—although, in the case of Poldhu, it might more correctly be called an insurrection. There were many difficulties in the way of tuning against local disturbance, and it was evident that the enemy to anything like syntony would be found in the law of inverse squares. Wireless telegraphy was really a means of signalling to be employed when no other means was available, and was only applicable to cases of shore to ship communication, where there was no cable. He did not consider that it would ever compete with cable lines in the matter of reliability.

Mr. J. Gavey referred to the difficulty in carrying out experiments in syntony owing to the extensive equipment required. Syntonised installations over 60 to 100 miles distance could be established with certain results, but beyond that we had very uncertain knowledge. Sharp tuning was not successful in preventing interruption beyond a certain range. In certain circumstances, as, for instance, in the case of two systems tuned respectively for long or short waves, and near together, there might not be mutual interference, and the question turned largely on the sensitiveness of the receivers, of which there were several types of equal value. He had used a simple type, consisting of a sharp-pointed carbon pencil, resting on a spring, with a drop of oil at the point of contact, and had taken up signals of all kinds, including messages from stations in both England and France. He did not think it possible to separate the electro-magnetic and leakage systems; in practice, the effective range of the electro-magnetic system was somewhere about 8 miles. Owing to the long lengths of parallel wires which were necessary the leakage system was not so applicable to ships and lighthouses as the Hertzian system.

Mr. Granville referred to experiments conducted in conjunction with Mr. Willoughby Smith, from which he had come to the conclusion that a conducting layer of attenuated atmosphere, which surrounds the globe at a distance of 50 miles from the surface, has very much to do with the results obtained from wireless experiments. He remarked on the similarity of the earth to a condenser, the non-conducting atmosphere being a comparatively thin layer of dielectric, and said that the conduction of the earth's surface and the upper atmospheric layer should not be ignored.

We may here remark, however, that this theory cannot be justified, as in the matter of interference the upper layer of attenuated atmosphere is obviously far above the many objects on, and the irregularity in the contour of, the earth's surface, which have been proved to exercise an influence on transmission over land. Also we have to account for the well-known difference in speeds of working and effectiveness which exist on land and sea, but which could not be appreciable if the medium of transmission were situated so far from the earth's surface.

The speaker concluded his remarks by reference to the use of lenses and reflectors in connection with Hertzian waves, which he considered would be attended with many difficulties, due to the earth's curvature and diffraction.

Gen. Webber gave some information regarding results on earth conduction methods. The system had been used, in wells about 20 ft. deep, over distances of 10 miles, and in mines with depths of 800 to 1,000 ft., over distances of 100 miles, the disturbances being set up by sensitive interrupters. As regards aerial communication, Capt. Jackson had collected a great amount of data on the subject of interruptions during the last six years, and these would be published shortly.

Mr. Alex. Siemens advocated the application of wireless telegraphy to those things for which it was adapted, such as ship and shore communication and trains. He considered that Marconi made a great mistake in trying the most difficult task first. It was admirably adapted for certain purposes, and for these it should be used, and extended to other things as we gained increased knowledge.

Mr. Pochin, in replying to the discussion, said that the sooner we faced the solid facts of ordinary working, and left newspaper articles, the better it would be. He agreed as to the excellent results to be obtained from the coherer mentioned by Mr. Gavey, and elicited that Mr. Granville's results were due to experiments with suspended vacuum tubes. The results of earth conduction experiments were much better than he had expected. In regard to interference, a large iron plate, especially if earthed, was an impenetrable bar to communication.

APPLICATIONS OF ELECTRICITY TO DRIVING CARRIAGES IN TOWNS.

By Lieutenant-Colonel Rookes Evelyn Bell Crompton, C.B. M.Inst C.E.

During the last year we have all noticed the very considerable development of motor-cars in London. A large number of these are electrically driven—that is to say, they carry their motive power in the form of stored energy in accumulators, which are charged at charging stations from the mains of the electric lighting companies.

In a paper on this subject recently read before the Institution by Mr. Henry Francis Joel many interesting facts were brought forward. A table of comparative working costs of automobile vehicles was given, showing that the cost of working a four-passenger London cab was 15s. 4d. per day; a motor-car worked by petrol 14s. 2d. per day, and a light steam-car about the same figure; whereas for an electric cab or brougham the cost varied between 14s. and 17s. per day; at any rate a good case was made for electrically-propelled vehicles.

Since the reading of that paper the development in electrical vehicles has been very considerable. It is probable that in two years' time the number in use will reach into thousands.

Transmission Gear.—During the very trying winter we have passed through, in which the greasy and hence dangerous condition of the streets has been singularly unfavourable for automobile traffic—I allude to the danger from side slip—it is noticeable how well the electrical vehicles have stood this ordeal, and how few accidents have occurred with them from side slip. This is partly due to the fact that it is a comparatively easy matter to apply the driving power to the front wheels, which are also the steering wheels, and this undoubtedly constitutes one of the great advantages of electrical propulsion. Electrical vehicles also possess an important advantage over petrol or steam-driven cars, in that it is so easy to apply separate power to each driving wheel, that there is no necessity for the complication introduced by the use of differential gear. Up to the present, apparently the majority of electrical vehicles use tooth-gearing, in spite of the fact that chains are undoubtedly easier to lubricate and to maintain in good silent-running condition.

Storage Batteries Used.—Up to the present the storage batteries used are invariably of the lead-couple type, either with electrodes made active by Planté formation or of the E.P.S. type, with various modifications in the form of the grids or supports used to imprison the active material and prevent it falling away from the backing under the influence of vibration. The Edison battery, about which so much has been written, in which iron and oxide of nickel have been used, has not yet been put into a workable form, although much is expected from it. Apparently, however, it is not necessary to wait for the invention of a new form of accumulator, as there are several forms already in use which work very well, and which can be maintained at a moderate cost, and are included in the foregoing working costs per day.

In the author's opinion all that is necessary to reduce the cost of accumulators further is standardisation, that is to say, the supply of accumulators should be undertaken very much as the supply of fodder and forage for horses. Once standardisation of this class is carried out to such a point that standard boxes can be exchanged for others ready charged on the production of a subscription ticket, at a sufficient number of charging stations, the difficulties and risks of this method of mechanical propulsion become greatly lessened; in fact, they practically disappear. A good deal remains to be done in the direction of such standardisation, and there appears now to be an opening for a company having considerable capital to establish charging depôts where such standardised accumulators can be supplied to the owners of electrical vehicles.

Tires.—The cost of tire-upkeep in this form of motor-car has been found to be unexpectedly high, although a good many of them use the less expensive form, namely, solid rubber. This high cost of upkeep of tires is probably due to the vehicles being rather heavy, and probably also because the mileage run by them is very considerable. Also, probably on account of supposed facility in arranging the gearing, the wheels of these cars have in many cases been unnecessarily small, and it is known that the deterioration of solid rubber tires increases in proportion to the number of revolutions made by the wheels. Theoretically, solid rubber tires are a mistake, but on account of the heavy patent charges on pneumatic tires, the latter do not at present compete with them in price.

Another matter is the extent to which the cost of electricity for charging these motors can be reduced, provided that the electricity is supplied during certain hours, during which the plant is generally only partially loaded. Prices as low as 1½d. per unit have already been mentioned; the price of 17s. a day, quoted from Mr. Joel's paper, is based on electricity at 4½d. per unit.

Discussion.

The discussion on the paper was opened by Sir E. Carbutt, who, referring to his own experience with a touring car weighing some 2½ tons, commented on the expensive character of the tires, which might be due to some extent to the heavy car. He emphasised the necessity for methods of standardisation, more especially in battery equipments, and instanced the practice of the Electromobile Co., who gave facilities to subscribers for obtaining re-charged batteries,

for any of their vehicles, and also insured them if required. He estimated that a sum of £360 to £640 per annum covered all running and up-keep expenses, including renewals of tires. He mentioned the difficulty in getting the battery re-charged when touring. His present car was constructed by Messrs. Greenwood & Batley, Leeds, and weighed 26 cwts., the battery weighing 8 cwts. There were five speeds, ranging up to 15 miles per hour, and he estimated the life of the battery at six to nine months, at a cost of £50.

Mr. T. E. Gatehouse said that two or three months ago a new cell had been brought before his notice. He had no interest whatever in the new cell, except the interest that one in his position would naturally take in a new invention or discovery, or a real improvement in the apparatus already in existence. The cell seemed to him to possess such remarkable attributes that he thought it his duty to the electro-technical industry to bring it before the meeting that day. The figures given were not his, but were taken partly from practical data obtained by the inventor during various runs, and partly from a report made by Mr. Llewellyn Preece, who for some time past had been investigating the properties of the battery. He therefore disclaimed any responsibility for these.

The invention was in the names of Elieson and Bobinsky, but he would make use of the first name only. The Elieson cell, he said, was a pure Planté cell, and, as constructed up to the present, consisted of five plates, two positive and three negative, weighing altogether 16 lbs. The total weight of cell, complete with box and acid, is 22 lbs., and it has a capacity of 100 ampere-hours at a 5-hours' duration of discharge. The plate consists of a central conductor formed of a leaden tube placed vertically in the centre of the plate. From this on either side branch out thin laminæ of lead. These laminæ are alternately corrugated and plain. The inner ends (*i.e.*, next the tube) of all the laminæ are burnt together, and the half-plate so formed is burnt on to the tube. The outer ends of the laminæ are thus left perfectly free to expand both horizontally and vertically in the plane of the plate. The construction of the positive and negative plates is identical, the only difference being in the thickness.

One of the principal drawbacks in secondary batteries is buckling, but this is obviated in the Elieson cell by the fact that the current, being led in by the central conductor, is evenly distributed through the laminæ on either side, and also that the laminæ are free to expand as above explained, and consequently buckling is quite impossible.

Another objection is the slow charge and discharge rates of cells, especially with the pasted type. This is owing to the fact with paste cells the active surface exposed to the action of the electrolyte and the circulation of the electrolyte itself is insufficient to deal with a strong current very rapidly.

In the Elieson cell the whole plate except the central tube is active surface right through, and being perfectly porous permits free circulation of the electrolyte. This is shown very clearly by the fact that while at a discharge rate of 20 amperes the capacity of the cell is 100 ampere-hours, when the discharge rate is 50 amperes the capacity is still 90 ampere-hours, and even at the absurdly high rate of 100 amperes a capacity of 73 ampere-hours is still obtained.

In charging the same thing holds good. While most cells on the market take four, five, or more hours to charge, the Elieson cell can be charged easily in from 40 to 45 minutes without any loss of capacity, and with a very high ampere-hour efficiency. The watt-hour efficiency is bound to be lower with high rates of charge, owing to the C^2R loss from the internal resistance of the cell, but even this (the watt-hour efficiency) remains creditably high, as the cell in question has an internal resistance of only ·003 to ·004 ohm. Then with paste cells the paste is always liable to become loose, and eventually to drop out and cause loss of capacity, and sometimes short circuits between the plates. This is especially the case in traction work, where the cells have to stand a great deal of vibration and considerable shocks. In the Elieson cell the peroxide of lead is formed electrically all over the surface of the lead, and is part of the plate itself. Again, when cells are left idle for long periods, especially when discharged, a great deal of sulphating takes place, which can never be got rid of owing to the low rate of charging. In the Elieson cell the same action, of course, goes on, but with the high rate of charge possible the sulphate is entirely driven off, and the cell remains as good as ever. Most of the cells on the market are very heavy, considering their output. There are a few cells of the pasted type which compare with the Elieson cell as regards the relation of output to weight, but they have a short life, and will not stand very rough usage.

As regards price, the Elieson will undoubtedly compare favourably with other types of cell, owing to the simplicity of the process of construction, and the cost of maintenance should be extremely low, as the only part of the cell which deteriorates is the positive plates. The negatives are practically indestructible. Consequently, all that is necessary when the positives are worn out is to replace them alone, and the battery is as good as new.

A great advantage in the Elieson cell is the small number of plates compared with most cells. Although at present the cells are made with five plates, in future the standard size of cell for motor-cars is to be a three-plate cell with 160 ampere-hours capacity. One advantage of this is that the plates are much thicker than is usual in accumulators, and consequently mechanically much stronger.

It is practically impossible to injure these plates electrically. They may be allowed to stand idle for any length of time, so that they become covered all over with sulphate, and then after two or three charges with a large current they completely recover, and the sulphate all disappears. This was the case with a battery at present in use in a motor-car belonging to the company. When it was put into the car it had been left neglected for weeks, and was in a very bad condition, but after a few days of running it completely recovered. The cells may be short-circuited when discharged and left till they are run down to zero without any bad effects. This was done in a test carried out by Mr. Llewellyn Preece. They may also be reversed accidentally without damage, which has frequently occurred while experimenting; in fact, if so desired, the battery may be completely reversed. Another striking characteristic of the cell is that while it can be charged to its full capacity in about three-quarters of an hour, it may be charged up to two-thirds of its capacity in 15 minutes. The cells tested by Mr. Preece were charged over and over again at the rate of 250 amperes for 15 minutes, *i.e.*, at the rate of 2½ times the total one-hour capacity of the cell.

The tests made by him extended over about five weeks, during which time over 90 experiments were carried out. The longest time occupied in charging was 1½ hours, and the shortest (up to full capacity) 42 minutes. Discharges were taken at 20, 30, 50 and 100 amperes, and the following figures are the average results at each of these rates:—

Amp.-hrs. charged.	Watt-hrs. charged.	Rate of discharge.	Amp.-hrs. discharged.	Watt-hrs. discharged.	Amp.-hrs. efficiency.	Watt-hrs. efficiency.
114	312	20	104	197	91	63
112	320	30	97	180	87	56
109	303	50	90	154	83	51
108	300	100	71	112	65	38

In the above experiments one or two points must not be overlooked. The cells were treated very roughly, and frequently left discharged over night. The watt-hour efficiency would also have been higher if the charging had not been so rapid, and, in fact, in some experiments it was higher.

Taking a normal discharge rate of 20 amperes, the cell gave an average of 8·95 watt-hours per lb. of complete cell. This is a somewhat low figure, and has often been beaten by paste cells, but probably at the expense of their durability.

The following is an example of the 15 minutes' charge:—

63 ampere-hours, 200 watt-hours, were charged in 15 minutes.

63 ampere-hours, 120 watt-hours, discharged at 20 amperes.

In this test, as in all others, the cell was discharged to 1·5 volts with 20 amperes *before* charging.

A practical test has been made of the Elieson battery in a small car. Twenty-four cells have been put in this car connected in two batteries of 12 cells each, in parallel, thus running on 24 volts. The cells are invariably charged at about 95 amperes, which is the largest current obtainable at the garage, but they have frequently been charged elsewhere at 120 amperes when such a current could be obtained. For charging the two batteries are in series. The full charge is about 8 B.T.U. This car has been running regularly since Easter, and has frequently had two charges in a day. Some of the principal runs are as follows:—

1.—A run was made to Reading with only 18 cells (two batteries of nine cells each, *i.e.*, 18 volts). The car was charged there in about an hour, and came back on that charge to London the same day. Distance 40 miles each way, two passengers.

2. Another run was made to Reading in 3 hours 25 minutes. As the battery was not nearly discharged, a further run was made of 10 miles, and the battery was still not fully discharged. Distance, 50 miles; two passengers.

3. The following day the car was charged in 1½ hours, and ran back to London with one passenger in 2 hours 50 minutes.

4. At Whitsuntide the following tour was undertaken:—On Friday, May 29th, the car ran with two passengers from London to Bedford, in all 56 miles on one charge, a few miles having been run in London before starting. It was charged again in Bedford in 1½ hours, and ran on the 30th 30 miles to Conington. On Sunday 31st it ran a further 9 miles to Peterborough without any further charge. The car was charged there in 1½ hours, and ran back to Conington, where it remained the night, and on June 1st without further charge ran back to Bedford by a longer and very hilly road of 32 miles. It was there charged in 1½ hours, and a start at once made for London.

At Barnet, about 40 miles, two of the screws holding the motor were found to have given way, so, as it was late, the car remained there for the night, and the following afternoon was driven back to London without further charge. The cyclometer, which is known to be accurate, registered 195 miles for the whole tour, *i.e.*, 195 miles on four charges, or an average of 49 miles per charge, lasting only 1½ hours each. The weight of the car is about 600 lbs. The weight of battery is about 530 lbs. Total weight without passengers, say, 1,150 lbs. The car runs at an average speed of about 12 miles an hour on good country roads, and, in going up hills, as much as 90 amperes is frequently used by the motor, of ¾ H.P. nominal only, *i.e.*, 45 amperes from each battery.

The following are the advantages claimed for the Elieson cell over other cells at present in existence:—

1. Lightness of cell with regard to capacity.
2. Simplicity of construction and small number of plates.
3. Mechanical strength of construction, and durability.
4. Impossibility of buckling.
5. Low cost of plates and consequently of maintenance.
6. No loss of paste, and consequently no loss of capacity or possibility of short-circuiting in the cell.
7. Cell will stand very rough usage, vibration, short circuiting, temporary reversal, or long periods of idleness without permanent damage.
8. High efficiency.
9. Small diminution of capacity at abnormally high discharge rates.
10. The extraordinary rapidity with which the cell absorbs its

charge, *i.e.*, in about three-quarters of an hour, as against at least several hours with most cells, thus entirely obviating the necessity of the cumbersome work of replacing a discharged battery by a charged one in motor-cars.

Mr. THEODORE CHAMBERS said that it was eight years since the introduction of the electric carriage into France, and he supposed it was due to prejudice that they had not been used to any extent in Britain. In the matter of expense a town carriage would cost £1 a day, but it had the advantage over horses of great mileage. One of his company's carriages had covered 850 miles in May, or at the rate of 10,000 miles per annum. The cost of pneumatic tyres came to £100 per annum, Garage charges, say, £200, and driver £100, making a total of £400 for running and repairs per annum, which he saw no possibility in reducing. Two London companies supplied energy for charging purposes at rates of 1½d. and less per unit, but at too high a voltage, so that allowing for incidental expenses, the rate would be near 3d. per unit.

Mr. H. F. JOEL's experience with cars of foreign manufacture did not appear to have been a happy one. He could not agree with the practice of driving on to the front wheel, but considered there was less chance of slipping when driving on to the hind wheels, and for hill climbing this was by far the best place. He quite agreed as to the efficiency of the chain drives. Touching the comparative costs of light and heavy batteries of similar outputs, he gave the following particulars:—

A.—BATTERY OF COMPARATIVELY LARGE OUTPUT FOR WEIGHT.

Weight of battery	6 cwt.
Output of battery on one charge .. 12 effective H.P.-hours At 56 lbs. for 1 H.P.-hour (Or 8·952 KW.-hours).	
Carriage for hire, weight ..	8 cwt.
Load (5 persons)..	6 cwt.
Total weight	20 cwt.
Duty 20 miles per day for 275 working days ..	5 500 ton-miles
Efficiency of carriage on good level roads, say, 120 watt-hours per ton-mile	
Miles run in practical use on one charge and discharge at efficiency rate would be 74·6 ton-miles, but allowing a margin for ascending hills and some loss when standing, this is taken one-third less, or	50 ton-miles
Total number of charges and discharges at 50 ton-miles each, complete charge and discharge	110
Cost of carriage, battery, 6 cwt. at £7 cwt., £42; carriage with motor and gear, £260..	£3 2
Cost to run per day of 20 miles—	
Electric energy with allowance for loss between charge and discharge, and the one-third added as above = 4 units at 1½d. unit	s. d. 6
Lubrication, and tires for 275 days, tires 10d.	1 0½
Rent of garage and labour per day	1 0
Driver per day	6 6
Interest on outlay at 5 per cent. per annum per day	10
Depreciation of battery at 60 per cent. per annum per day	1 4½
Depreciation of carriage at 15 per cent. per annum per day	2 6
Total cost per day ..	13 9
	s. d.
Earning power at 1s. mile ..	20 0
Profit per day	6 3

B.—BATTERY OF TWICE THE WEIGHT AND TWICE THE DURABILITY, BUT SAME OUTPUT.

Weight of battery	12 cwt.
Output of battery on one charge .. 12 effective H.P.-hours At 1½ lbs. for 1 H.P.-hour	
Carriage weight	12 cwt.
Load (5 persons)..	6 cwt.
Total weight	33 cwt.
Duty 20 miles per day for 267 working days ..	7,380 ton-miles
Efficiency of carriage on good level roads, say, 120 watt-hours per ton-mile	
Miles run in practical use on one charge and discharge at efficiency rate would be 49·8 ton-miles, but allowing a margin for ascending hills and some loss when standing, this is taken one-third less, or	33·3 ton-miles
Total number of charges and discharges at 33·3 ton-miles, each complete charge and discharge	220
Cost of carriage, battery, 12 cwt. at £6 cwt., £72; carriage with motor gears, &c., £280	£352
Cost to run per day of 20 miles—	
Electric energy with allowance for loss between charge and discharge and one-third added as above = 6 units at 1½d. unit	s. d. 9
Lubrication and tires for 275 days, tires 1s 3d. .. .	1 5½
Rent of garage and labour per day	1 0
Driver per day	6 6
Interest per annum at 5 per cent. each day	11½
Depreciation of battery at 40 per cent. per annum per day	1 7
Depreciation of carriage at 15 per cent. per annum per day	2 10
Total cost per day.. ..	15 1
	s. d.
Earning power at 1s. mile ..	20 0
Profit per day	4 11

From the above statement it would appear to be more profitable to use a light battery with large output, in preference to a heavy battery, having the same output but of greater durability. These comparative results are subject, essentially, to the sale price, the length of life, and comparative depreciation of the two batteries. Thus, if the lighter weight battery is sold at the same price as the heavier battery (the output being the same), then the increased depreciation, by adding 1s., would make the total cost of column A 14s. 9d.; and again, if the life of either or both of the batteries is increased, and the depreciation be reduced in proportion, this would materially affect the result. The run of 20 miles per day may be increased to 30 miles per day in each case. This would add 3d. for electric energy to the A column, and 4½d. for electric energy to the B column. A mean between the two columns A and B, battery 9 cwt., carriage 10 cwt., load 6 cwt., would give 6,600 ton-miles, 165 charges and discharges, and a total cost of 14s. 3½d. per day. A battery of a short life, say, half the durability of that on the A column, if sold at the same rate for output as the B battery, would bring the total in the A column to more than the B column; and again, a carriage of lighter construction, and yet strong enough to carry a heavier battery, would be more economical than even the example given in the A column, and these considerations all point to the conclusion arrived at in his paper on "Electric Automobiles," read before the Institution of Civil Engineers, Session 1902—1903 (Vol. cliii., Part II)—namely, that all things considered cars in which the weights of batteries, vehicles, and load are equal, are the most suitable for electrically propelled vehicles, providing that the annual depreciation of the battery does not exceed, say, 50 per cent. of the mean taken of the A and B batteries. Referring to the Elieson battery, he did not think it would be a lasting one, and he had obtained 12 to 15, and even 18, watt-hours per lb. of plate with the pasted type of cell.

Mr. P. W. NORTHEY considered that a great deal of the possible progress in electrically-propelled vehicles depended on the methods of working them, and in the proper use of the battery, no great improvement being possible in the efficiency of mechanism. Skidding on the backwheels would be avoided by driving on to them, and in the case of front-driven vehicles, they were now designed with a suitable proportion of weight on the front axle, making them equally suitable with other types for hill-climbing purposes. He preferred one motor driving on to a live axle as the most efficient method. He had known pasted cells to give 15 to 16 watt-hours per lb. of plate, but did not think this rate would continue for long. The Elieson battery contained fine laminations which would peroxidise through, and the satisfactory working would be dependent on pure electrolyte being used. He thought all rubber tires were a mistake, but solid rubber ones less so than others.

Mr. T. PARKER referred to the Elieson cell as being similar to one by Blot. His experience on the Bournbrook Tramways with accumulator traction, was that the battery lost its capacity by too rapid discharging. Electric motors were not suitable for hill climbing, which was a frequent cause of over discharging. He thought the costs given by previous speakers were excessive.

Mr. SHOOLBRED, referring to the charging difficulty, had advocated the establishing of what he termed electrical supply hydrants as a means of overcoming it. The majority of the supply stations worked at 200 to 250 volts, and but few at 100, so that in most cases the batteries could not be charged direct.

Mr. R. S. ERSKINE stated that the makers gave as the cost of running their electrical cars, from £350 to £400 per annum. In the case of a private car he knew, energy was obtained on the owner's premises at 2½d. per unit, and the cost per month averaged £2 1s. 4d.

Mr. H. JOLY called attention to the varying dimensions adopted by the makers of different cells which made it impossible to store them in any but their own boxes; this, he thought, pointed to the necessity for standardisation. He also referred briefly to the capacities of various types of cell, and thought that the cost of running was generally understated.

Mr. LLEWELLYN PREECE stated that he had tested both Planté and pasted type cells for motor-car work, and had come to the conclusion that, as regards capacity for weight, there was little to choose between the Planté (*i.e.*, Elieson cell) and the pasted cells. The great point with the Elieson cell was, that it could be charged in such a short time. If touring on a car fitted with this type of cell, it was a simple matter to re-charge the battery during lunch, and thus in one day cover double the distance capable of being obtained on one charge. With pasted cells, this was not possible, as it took at least four hours to re-charge the battery. The life of the various types of cells was a difficult question on which to obtain satisfactory and reliable figures. Unless the cells were actually under personal supervision continuously for many months, it was impossible to arrive at any conclusion. In ordinary practice the owners of cars knew nothing about batteries, and neglected them badly, and it was quite unfair to base any conclusions on results thus obtained. From his small experience he thought that the life of the pasted plate would be the longer, but with a steady diminution of capacity during the life. On the other hand, the Elieson cell would maintain its capacity more steadily, but give way suddenly after a comparatively shorter life, because whereas pasted cells continuously shed paste, and therefore capacity, in the Planté formation the capacity would remain steady until there was no more lead to peroxidise, when the "lamels" would break. Regarding standardisation, he did not think anything could be done in reducing the containers to one size. The Elieson plate could not satisfactorily be put into boxes 5 × 4, nor were pasted plates made suitable for boxes 9 in. × 2 in. He questioned whether such standardisation was necessary. On the other hand, it was very desirable to standardise the charging pressure. Unhappily, central station engineers and car manufacturers held widely different views on this point. In the near future all, or nearly all, supply stations would have a working pressure of 200 to 230 volts, and naturally they desired that this should be the charging pressure. On the other hand, it was most desirable to keep down the number of cells on a car as low as possible, for the larger the size of the individual cell, the greater was the capacity per lb. weight. Further, manufacturers in England, and he believed in France and Germany, were all equipping their cars with 40 to 44 cells and 80-volt motors, having practically agreed that this number of cells requiring 110 to 120 volts for charging should be the standard.

Lt.-Col. CROMPTON, in replying, summed up the discussion, from which he gathered that the automobile was confined to the rich; the cost of running frequently amounted to 9d. per mile, a prohibitory figure. He further added a glowing "every man his own driver" picture, which we understood represented his ideal of the electrically-propelled vehicle. A charge of 2d. per unit for energy for charging purposes represented about ½d. per mile for electricity, and tires might be put at 75d. per mile as soon as the patents expired; attendance he estimated at 3d. per mile, but the great point about accumulator cars was that they could do without an attendant (a view, however, which is not shared by the metropolitan police). He looked forward to a time a few years hence, when these conditions would be altered, and then the speed of traffic in the streets would be increased from its present average of 5 miles to 10 miles per hour.

INTERNAL COMBUSTION ENGINES FOR DRIVING DYNAMOS.

Mr. H. A. HUMPHREY's paper dealt with the subject of large gas engines in a somewhat limited manner, but it evoked perhaps more discussion on this account. If we heard him aright, Dr.

Hopkinson debited the steam engine with consuming 8 lbs. of coal per kilowatt-hour in lighting stations, a statement to which Dr. Kennedy objected. The two doctors engaged in a debate across the benches, which was to us inaudible, and suggests that speakers would perhaps be better heard if called up to the platform to speak. Mr. Davey asked for information on producers, of which the paper told us nothing except in regard to the Mond system, which is rather a system for producing heating gas in large quantities and saving bye-products, a system that is hardly suitable for a small work.

Mr. Robinson, and others whose names we failed to hear, discussed the question of water-cooled pistons, and Mr. M. Longridge told us that if a satisfactory producer were forthcoming he could almost promise orders forthwith.

Mr. W. H. Booth pointed out he had made the first test of a gas engine driven by blast-furnace gas some seven years ago. In that seven years English ironmasters had done very little in this line, but the Germans and Belgians had done much, and it was to blast-furnace gas that the many large Continental gas engines owed their origin. He also pointed out the danger of gases containing too much hydrogen. Such gases could not stand much compression without premature explosion, and hence the excellence of B.F. gas and producer gas free from hydrogen for power generation purposes.

Mr. Campbell endorsed Mr. Booth's remarks, and said that if English manufacturers wanted big gas engines, they could get them made by English engineers. The large gas engines of the Continent were made because an opportunity had been offered. Mr. Humphreys was asked what proportion of the tabulated horse-power quoted in his appendix was derived from B.F. gas. It appears to us that the demand for gas engines to run alternators is a little unreal. There are so many outlets for power, and so much blast-furnace gas is going to waste, that the demand for gas engines to do the most difficult work savours of pedantry when so much simpler work is to be done. It appears as though our big consulting engineers had not the ability to face the gas-power question, and would leave it alone for younger men, and thus it comes about that so much froth is displayed and so little is done. Mr. A. J. Lawson drew attention to the Diesel engine, which he was employing in traction work. The Diesel principle ought to be taken up by the gas men who make hydrogenous gas, for it would save their position.

TRANSMISSION AND DISTRIBUTION BY SINGLE-PHASE ALTERNATING CURRENT.

The paper read by Mr. E. W. Monkhouse, M.A., M.I.C.E., consisted of a few general remarks as to the unsuitability of continuous current for high voltage transmission, the disadvantages and inefficiency of transforming alternating to continuous current, the simplicity of single-phase as compared with three-phase, and a passing reference to the Baltimore and Annapolis Railway, in which "the speed control is effected by an induction regulator, thus avoiding the use of resistances which absorb power."

Naturally, the thing fell very flat, and the chairman, Mr. A. Siemens, made a brave attempt to start a discussion. He was immensely relieved when Dr. E. Hopkinson entered the room, and at once called on that gentleman to say something on the subject, but Dr. Hopkinson had nothing to say. Mr. A. H. Preece and Mr. Burstall told the meeting that they had seen alternating current motors actually working, and the audience marvelled. On Mr. Frank Broadbent pointing out that the motors on the Baltimore and Annapolis Railway were not the kind of alternating motors that Mr. Monkhouse had previously referred to, but were constructed like continuous current motors, with commutators, Mr. Siemens remembered that he had carried out some experiments on driving such motors with single-phase alternating currents, and had contributed a paper to the Institution of Electrical Engineers somewhere about 1891.

In replying to the discussion, Mr. Monkhouse said the paper was just a fishing one, intended to draw manufacturers.

It failed utterly.

AUTOMATIC SIGNALLING.

By William John Cudworth, M.Inst.C.E.

(Abstract.)

Automatic signalling, *i.e.*, signalling by means of which railway trains themselves actuate the signals protecting them without the attendance of signalmen, has been the dream of the inventor since the introduction of railway signalling.

Countless plans have been proposed. Most of them, however, depend for their action upon a contact between something depending from the train and apparatus fixed upon the permanent-way, which contact does either mechanical or electrical work.

Allusion must be made to the successful working of contact apparatus in special cases, such as the Liverpool Overhead Railway (described by Mr. Cottrell, M.Inst.C.E., in Vol. cxliv., of, the *Proceedings* of the Institution). Mention must also be made of the various treadle systems auxiliary to the ordinary block system, which, although they do not supersede the human agent, as is the aim of the automatic system, do, at any rate, provide an automatic check upon his fallibility.

In the United States experiments were conducted between 20 and 25 years ago, and some automatic signalling installations made, which depended for their action on the short-circuiting of a low-voltage electric current running through the rails, by the wheels of vehicles thereon, or on what is now known as a track-circuit.

The introduction of track-circuit working gave a great impetus to automatic signalling, and it rapidly spread in the States. In January, 1902, 3,354 miles, on 40 different railroads, were so worked; and the system can no longer be considered as in the experimental stage. In this country it has been adopted on the main line of the London and South-Western Railway between Andover and Grateley (5½ miles), and on the North-Eastern Railway main line between Alne and Tursk (10 miles). The latter installation is not as yet completed.

The systems in most frequent use in the United States are the electro-pneumatic and the Hall system, the latter being either electric or electro-gas. A favourite system, where economy of construction is important, is the polarised track-circuit system, which dispenses with line-wires and has motor-worked signals. A polarised relay is provided in connection with the track-circuit, and a pole-changer is attached to each home-signal, which reverses the current in this circuit when the signal is moved, thus getting double service out of it. The Hall system is that now being installed on the North-Eastern Railway, whilst that introduced on the London and South-Western Railway is an electro-pneumatic system, differing, however, from those commonly used in the United States in that air at a pressure of 10 lbs. to 20 lbs. per square inch, instead of at 80 lbs. or 90 lbs. per square inch, is used.

In the electro-pneumatic system, power stations and air-compressors are provided at suitable intervals. In an installation about to be put down on the London and South-Western Railway, one power station situated near the centre will serve for a distance of 23 miles. Pneumatic pressure is conveyed thence in pipes the whole length of the installation, with branches to all signals. Each signal-arm is worked by means of a rod connected with a piston actuated by pneumatic pressure. The pressure is admitted to or withdrawn from the piston by means of a pin-valve actuated by an electro-magnet in circuit with a signal battery, which again is under the control of the track battery circuit.

The system, as carried out on the London and South-Western Railway, is "normal clear," *i.e.*, all signals stand at safety unless they are required to be at danger for the protection of occupied sections. When a train enters a section it puts to danger the signal at the entrance to that section, maintaining it in that position until it passes out of the section *in advance*, when the current is re-established and the arm is pulled off; there are thus two home-signals, one a section behind the other, with their corresponding distant-signals, to protect a train.

The system being installed on the North-Eastern Railway is that known as "normal danger," *i.e.*, the signals stand normally on, are brought to safety by an approaching train, and restored to the danger position when the train has passed. Its general lines are similar to those of the London and South-Western system so far as the track and signal batteries are concerned. Special appliances have, however, to be added to effect the pulling off of the signals. The source of power also is different, as it is stored at the foot of each signal post in the form of liquefied carbonic acid gas, at a pressure of about 800 lbs. per sq. in., in two removable steel cylinders, to be used alternately, one being removed for filling whilst the other is in use. Each cylinder of gas will suffice for 6,000 to 7,000 operations of the signal, and the working pressure is about 50 lbs. per sq. in.

The independent supply of power to each signal is probably more economical in first cost than a continuous supply of power over great lengths of line from a central power station, but whether it will be equally economical in maintenance, and equally reliable, is a matter for experiment.

Both systems described are applicable to lines containing junctions and stations; and there would, therefore, seem to be an extensive field for their adoption in this country. At branch junctions no attendance would be required, except for so long as the branch line is open, and at roadside stations only when shunting is actually going on, and such attention could readily be given by the station staff.

In addition to the contact systems mentioned, and the track circuit systems with ordinary semaphore signals already described, mention should be made of other systems, such as the Miller system and the Boult system, which give their signals in the cab of the engine. The former is worked with a track circuit, and is in use in the tunnel outside the Grand Central Station at New York, and also at the west end of the Woodhead Tunnel on the Great Central Railway.* Both systems can be worked with or without outside signals; but it could hardly be said that full advantage is taken of them, unless these be dispensed with; and whether this would be desirable is an open question.

Discussion.

Mr. Rayner Wilson, who opened the discussion, would have liked more information as to the economy of automatic signalling, and the number of signal-boxes which were dispensed with. He had heard that the Hall Co. had 1,100 electro-gas signals on order, and the Baltimore and Ohio Railway were replacing the whole of their motor signals by those of the electro-gas type. As a result of a comparison with a "2½ man" signal box he found signalmen's wages came to £238 per annum, as against £63, estimated interest and sinking fund for an automatic signal plant. Track circuits had great advantages, but there were difficulties in the use of the Mansell wheel.

Mr. Elliot Cooper pointed out that the real question was as to how automatic signalling arrangements would affect the traffic. In the case of mixed traffic and when breakdowns occurred, it appeared to him that automatic signalling might prove somewhat difficult of application, although very suitable for tubes and direct traffic. He had given a firm permission to fit an installation in the cab of one of his company's locomotives, which, however, had not been done.

*This was fully described in our issues of February 13th and March 6th, 1903.

He thought the inventors wanted the companies to do their experimenting for them.

Mr. Jacomb Hood, speaking for his company (S.W. Railway), said that automatic signalling had been in use for two years, and they had come to the conclusion that it was the thing for them; during this time no failures had occurred (in the sense of a signal being off when it should have been on). He pointed out to the author of the paper that there was only one stop signal behind a train, and he thought that, if anything, the system might be called normally "danger" (not "clear"). The economy was more in working advantages than in cost. On the S.W. Railway all section posts were telephonically linked to the nearest section signal boxes. He failed to see that any difficulty should arise in case of breakdown.

Mr. Cudworth, in replying, was convinced that there was economy in automatic signalling. He would not propose to equip large stations and junctions where shunting operations took place. In the matter of breakdowns, standard regulations were in force on all railways, which covered all possible cases. With reference to the terms "normal clear" and "normal danger," he had followed the American practice; he recognised that normal danger was, if anything, the better position as, for instance, through long standing in one position in the winter a signal might be frozen, and it would be much better to have a false "danger" than a false "clear" indication.

Taken as a whole the discussion was disappointing, as the representatives of the purely automatic electric (Miller) and of the "Crewe" system employed on the L. & N.W., if present, did not contribute in any way to it, and the commercial aspect of the question was practically untouched.

CARDIFF STREET LIGHTING.

The street lighting of Cardiff has just undergone an entire change. Before giving a description of it as it is at the present time, it is interesting to note that the streets were previously lighted by rectified arcs, Cardiff being one of the earliest towns to adopt this system. The arcs were enclosed in lanterns of the city type, being some 22 ft. from the ground. The streets were fairly lighted, the chief complaint being that there was far more light overhead than on the ground.

When the tramways system was installed, the old lamp standards had to be removed from the centre of the road to make way for the tramway poles. This being the case, it was decided that they should be done away with altogether, and that the lamps, wherever possible, should be fitted on the tramway standards.

After sundry experiments had been carried out, it was decided to use the enclosed type of arc lamp, suspended from brackets, the arc being only some 16 ft. from the ground. The type of lamp that was adopted after careful trials was the Davy, supplied by Arc Lamps, Ltd. This was selected as giving the best results under the conditions required, and at the same time having a most pleasing appearance. The photograph in fig. 1 shows one of the centre poles, with double brackets; fig. 2, a specimen side pole (span wire) with single brackets; and fig. 3, is an example of the bracket poles with special attachment.

In the centre portion of the town the brackets are fixed on every pole, whilst in the suburbs they are fixed on every other pole, and this is found to give a very fair lighting effect. The poles on an average are 38 to 40 yards apart. The lamps are twin carbon single-globe enclosed, working direct off 200-volt distributing mains. They were specially designed by Mr. Davy, and are the first of the type made as far as we are aware. The switches are all specially designed as are also the joint or tee boxes in which the service connection is fused as it leaves the mains, the fuse being easily replaced without any danger of shock to the workman.

At the present time about 350 lamps are being fixed, the major portion being complete. Of this number of lamps about 120 will be supplied off the alternating system, but the arrangement is in every way the same, and the lamps with the exception of certain parts are so much alike that any of the parts requiring renewal are interchangeable.

The committee have been so satisfied with the result that they have called for estimates for completely equipping the whole of the tramway routes.

The whole of the fittings were designed, and the fitting up and equipment was carried out by the department under the direction of Mr. Arthur Ellis, the Cardiff Corporation electrical engineer.

As far as we are aware this is the first town in which twin enclosed arc lamps have been used in such manner, and at such a height from the ground.

Fig. 2.—Side Pole: Single Bracket.

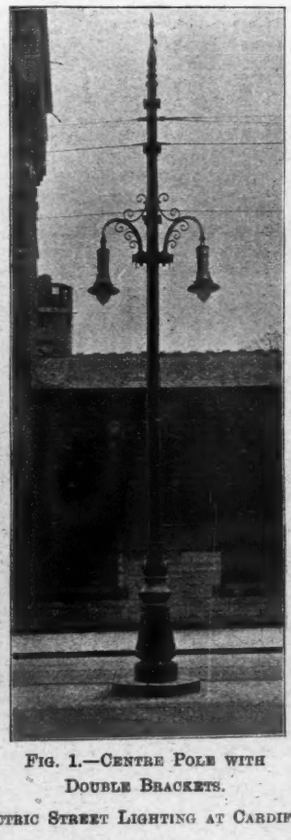


Fig. 1.—Centre Pole with Double Brackets.

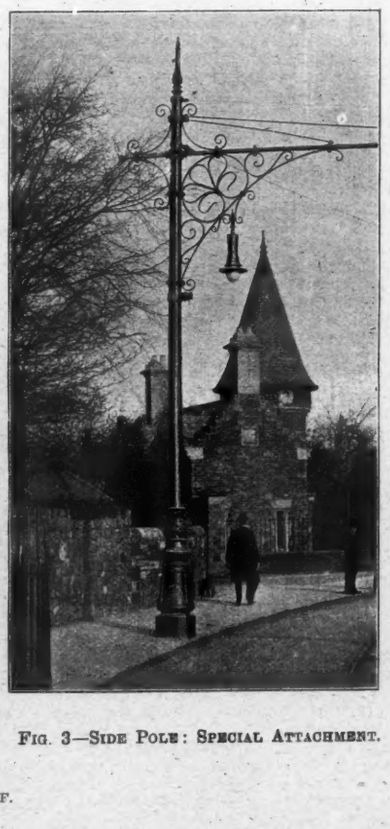


Fig. 3—Side Pole: Special Attachment.

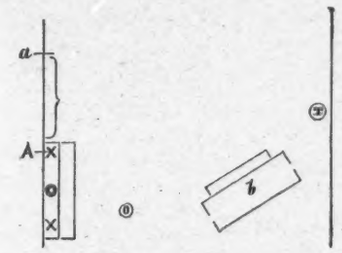
Electric Street Lighting at Cardiff.

EFFECTS OF A LIGHTNING FLASH.

The following description of the effects produced by a flash of lightning, which we have received from a correspondent, may be of interest, as well as adding to the list of vagaries usually displayed when a building is struck.

The flash was a single, very brilliant, one, preceded and followed by two minor ones, accompanied by a terrific peal of thunder, and proceeded from a passing very dark cloud about mid-day on the 16th inst. to the west of London. It struck a private school lying, one would have thought, well beneath the protection of the spire and its conductor of a neighbouring church, which, to the writer's own knowledge, successfully handled three big flashes in Whitsun Saturday's four-hour violent storm.

The house, necessarily a large one standing in its own grounds, was struck on the N.E. corner where one of a pair of tall chimneys and a gable gave a foothold, and the chimneys were capsized a distance of 25 ft. or so on to another building or wing used as laundry, where, needless to say, they did due execution in the way of smashing tiles and ridge; nothing in the nature of searing was observable either outside or inside the gable (where 1-in. plaster was forced off a dormitory ceiling to the extent of about 5 ft. by 3 ft.), the only unusual aspect being that both brick and red ornamental



ridge were pulverised or disintegrated. Further evidence of the flash in *that* portion of the building was not observable, but a curious effect occurred in a room situated a floor below, in the S.E. corner, and about 50 ft. from the point where the flash found purchase. To understand this it should be stated that a portion of the arrangement of the room (fortunately untenanted at the time) was as follows:—

After the flash, when the room was entered, there was found to be a hole in the wall at A, exposing brick work, about 6 in. diameter (with no metal work visible). The plaster from this was pulverised and burst outwards so violently as to adhere to a piano situated at *b* (about 7 ft. away), as though it had had its sides powdered with a flour dredger. A heavy brass candlestick, x (standing with its companion, and a heavy brass clock of the carriage type upon a writing desk) immediately opposite the opening, had been flung the other side of the room, and was found at *x* about 12 ft. from its home. The carriage clock was flung on to the floor at O (3 or 4 ft.), a long picture ⌐¬ had its glass smashed to pieces and frame in two halves, whilst at *a* there was a second but smaller hole in the wall about 1½ in. diameter, disclosing a ⅜ in. gas barrel embedded therein with a ¼ in. fuse mark. From observation the writer found the picture frame (about 30 in. × 12 in. of 1 in. gilt oak) reached in a direct line from the larger wall opening (practically from the candlestick) to the gas barrel, it was broken on the shorter sides, and the long sides showed the gilt alone fused to powder with no charred mark on woodwork, but an absolutely straight black mark of length equal to the side of the frame resting on it, ran along the wall paper showing the heat path and connecting the two holes in the wall. Above this picture was a much smaller one of rectangular shape; this had its glass intact, but the gilt on the moulding of this was burnt up in parts, whether by the original flash or an induced current one cannot tell, but, presumably, with two parallel closed circuits assuming a circular path taken in the larger frame, it is possible that the two frames acted as a transformer, primary and secondary—a theory delightful to contemplate in view of the enormous resistance of the films of gold with four breaks in each, due to joints. Possibly of more service in estimating the violently disruptive effect and force is the fact that a lace mat 4 in. sq., on which the candle-stick stood, was flung, torn, but flat, on to the piano keyboard. This, to anyone who has tried flinging similar fabrics any distance, is more striking than the candlestick or clock, as the distance was approximately 8 or 9 ft. It might be added that a wooden top rail of the desk was torn in half and flung into the doorway. Neither clock, candlestick nor mat, nor, in fact, aught but the gas barrel showed any fuse mark, and the only apparent charred mark was that beneath the picture frame, as a narrow line on the wall paper. Both clock and candlestick were, however, coated with an impalpable film or powder, easily removable with the fingers.

The highly destructive force employed was very striking, but possibly the most wonderful thing about the whole erratic performance is the fact that none of the household, masters, pupils and servants (one of the latter being in the laundry at the time when it hailed bricks) were hurt.

So far as one can theorise, it would seem that the cloud being to the S.W. of the church, over which the sky was comparatively clear in comparison, the flash taking a slanting course made a pot shot at the steeple, but under-estimating the distance fell short and found foothold at a point about two-thirds lower down and 150 yards nearer; in which case, assuming a head and tail, the former knocked the chimney over and the latter curled over and did the balance of execution described!

MANUFACTURE OF ELECTRICAL ACCUMULATORS.

The following are the draft regulations which have been issued under the Factory and Workshop Act, 1901:—

In these regulations "lead process" means pasting, casting, lead burning, or any work involving contact with dry salts of lead.

Any approval given by the Chief Inspector of Factories in pursuance of these regulations shall be given in writing, and may at any time be revoked by notice in writing signed by him.

Duties of Occupier.

1. Every room in which casting, pasting or lead burning is carried on shall contain at least 500 cb. ft. of air space for each person employed therein, and in computing this air space, no height above 14 ft. shall be taken into account.

These rooms, and that in which the plates are formed, shall be capable of through ventilation by means of windows made to open.

2. Each of the following processes shall be carried on in such manner and under such conditions as to secure effectual separation from one another and from any other process:—

(*a*) Manipulation of dry salts of lead.
(*b*) Pasting.
(*c*) Formation, and lead burning necessarily carried on therewith.
(*d*) Melting down of old plates.

Provided that manipulation of dry salts of lead carried on as in Regulation 5 (*b*) need not be separated from pasting.

3. The floors of the rooms in which manipulation of dry salts of lead or pasting is carried on shall be of cement or similar impervious material, and shall be kept constantly moist while work is being done.

Means shall be provided for washing the floors of these rooms with a hose pipe daily.

4. Every melting pot shall be covered with a hood and shaft so arranged as to remove the fumes and hot air from the workrooms.

Receptacles shall be provided for holding lead ashes and old plates.

5. Manipulation of dry salts of lead in the mixing of the paste or other processes, shall not be done except (*a*) in an apparatus so closed, or so arranged with an exhaust draught as to prevent the escape of dust into the work room; or (*b*) at a bench provided with (1) efficient exhaust draught and air guide so arranged as to draw the dust away from the worker, and (2) a grating on which each receptacle of the salt of lead in use at the time shall stand.

6. The benches at which pasting is done shall be covered with sheet-lead or other impervious material, and shall have raised edges.

7. No woman, young person, or child shall be employed in the manipulation of dry salts of lead or in pasting.

8. (*a*) A duly qualified medical practitioner (in these regulations referred to as the "Appointed Surgeon") who may be the certifying surgeon, shall be appointed by the occupier, such appointment, unless held by the certifying surgeon, to be subject to the approval of the Chief Inspector of Factories.

(*b*) Every person employed in a lead process shall be examined once a month by the Appointed Surgeon, who shall have power to suspend from employment in any lead process.

(*c*) No person after such suspension shall be employed in a lead process without written sanction entered in the Health Register by the Appointed Surgeon. It shall be sufficient compliance with this regulation for a written certificate to be given by the Appointed Surgeon and attached to the Health Register, such certificate to be replaced by a proper entry in the Health Register at the Appointed Surgeon's next visit.

(*d*) A Health Register in a form approved by the Chief Inspector of Factories shall be kept, and shall contain a list of all persons employed in lead processes. The Appointed Surgeon will enter in the Health Register the dates and results of his examinations of the persons employed and particulars of any directions given by him. He shall on a prescribed form furnish to the Chief Inspector of Factories on January 1st in each year a list of the persons suspended by him during the previous year, the cause and duration of such suspension, and the number of examinations made.

The Health Register shall be produced at any time when required by H.M. Inspectors of Factories or by the Certifying Surgeon or by the Appointed Surgeon.

9. Overalls shall be provided for all persons employed in manipulating dry salts of lead or in pasting.

The overalls shall be washed or renewed once every week.

10. The occupier shall provide and maintain:—

(*a*) A cloakroom in which workers can deposit clothing put off during working hours. Separate and suitable arrangements shall be made for the storage of the overalls required in Regulation 9.

(*b*) A dining room, unless the factory is closed during meal hours.

11. No person shall be allowed to introduce, keep, prepare or partake of any food, drink, or tobacco, in any room in which a lead process is carried on. Suitable provision shall be made for the deposit of food brought by the workers.

This regulation shall not apply to any sanitary drink provided by the occupier and approved by the Appointed Surgeon.

12. The occupier shall provide and maintain for the use of the persons employed in lead processes a lavatory, with soap, nail brushes, towels, and at least one lavatory basin for every five such persons. Each such basin shall be provided with a waste pipe, or the basins shall be placed on a trough fitted with a waste pipe. There shall be a constant supply of hot and cold water laid on to each basin.

Or, in the place of basins, the occupier shall provide and maintain troughs of enamel or similar smooth impervious material, in good repair, of a total length of 2 ft. for every five persons employed, fitted with waste pipes, and without plugs, with a sufficient supply of warm water constantly available.

The lavatory shall be kept thoroughly cleansed, and shall be supplied with a sufficient quantity of clean towels once every day.

13. Before each meal and before the end of the day's work, at least 10 minutes, in addition to the regular meal times, shall be allowed for washing to each person who has been employed in the manipulation of dry salts of lead or in pasting.

Provided that if the lavatory accommodation specially reserved for such persons exceeds that required by Regulation 12, the time allowance may be proportionately reduced, and that if there be one basin or 2 ft. of trough for each such person this Regulation shall not apply.

14. Sufficient bath accommodation shall be provided for all persons engaged in the manipulation of dry salts of lead or in pasting, with hot and cold water laid on, and a sufficient supply of soap and towels.

This rule shall not apply if, in consideration of the special circumstances of any particular case the Chief Inspector of Factories approves the use of local public baths when conveniently near, under the conditions (if any) named in such approval.

15. The floors and benches of each workroom shall be thoroughly cleansed daily, at a time when no other work is being carried on in the room.

DUTIES OF PERSONS EMPLOYED.

16. All persons employed in lead processes shall present themselves at the appointed times for examination by the Appointed Surgeon as provided in Regulation 8.

No person after suspension shall work in a lead process in any accumulator factory without written sanction entered in the Health Register by the Appointed Surgeon.

17. Every person employed in the manipulation of dry salts of lead or in pasting, shall wear the overalls provided under Regulation 9. The overalls, when not being worn, and clothing put off during working hours, shall be deposited in the places provided under Regulation 10.

18. No person shall introduce, keep, prepare, or partake of any food, drink (other than any sanitary drink provided by the occupier and approved by the Appointed Surgeon), or tobacco in any room in which a lead process is carried on.

19. No person employed in a lead process shall leave the premises or partake of meals without previously and carefully cleaning and washing the hands.

20. Every person employed in the manipulation of dry salts of lead or in pasting shall take a bath at least once a week.

21. No person shall in any way interfere, without the concurrence of the occupier or manager, with the means and appliances provided for the removal of the dust or fumes, and for the carrying out of these Regulations.

NEW PATENTS APPLIED FOR, 1903.

Compiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

12,829. "Improvements in and connected with telephone exchange systems." H. OPPENHEIMER. (Actiengesellschaft Mix & Genest, Germany.) June 8th.

12,887. "Improvements in electric motors." E. A. CAROLAN. (The General Electric Co., U.S.) June 8th.

12,888. "Improvements in electric heaters." E. A. CAROLAN. (The General Electric Co., U.S.) June 8th.

12,889. "Improvements in controllers for electric motors." E. A. CAROLAN. (The General Electric Co., U.S.) June 8th.

12,897. "A new electrolyte or battery solution." C. E. WARREN and J. CROWLEY. June 8th.

12,947. "An improved case for electric light fuseboards and switches." J. BOLTON. June 9th.

12,956. "Improvements in cut-outs for electric circuits." E. A. CAROLAN. (The General Electric Co., U.S.) June 9th.

12,968. "Improved and portable electric lamp." P. SCHWENKE. June 9th. (Complete.)

12,982. "Improvements in contact devices for electric railway and tramway systems." A. KUCHINKA. June 9th. (Complete.)

12,985. "Improvements in and relating to electrical automatic volt-regulators." E. MORAND. June 10th.

12,993. "Improvements in automatic circuit-makers and breakers." J. G. STATTER and C. J. SIMEON. June 10th.

13,009. "Improvements in trolley heads for electrically-propelled vehicles." J. MAJOR. June 10th.

13,051. "Improvements in electrodes for arc lights." F. J. GERARD. June 10th.

13,055. "An improved signalling key for use with Herz wave telegraphy." H. T. ELLIS. June 11th.

13,061. "Improved fuse head for electric blasting." F. RENNER. June 11th.

13,098. "Improvements in mercury current interrupters." R. OTTO. June 11th. (Complete.)

13,103. "Improvements in electrical cut-outs." H. KORTEN. June 11th.

13,153. "Improvements in shade holders for electric lamps." G. CHISHOLM. June 12th.

13,176. "Improvements in electric vehicles." G. GIBBS and H. PEARSON. June 12th. (Date applied for under Patents Act, 1901, October 2nd, 1902, being date of application in United States.) (Complete.)

13,190. "Improvements in or relating to apparatus for operating electric bells, spark coils and the like." F. C. MORRIS. June 12th.

13,221. "Improvements in magneto semaphore mechanism." THE MAGNET ELECTRIC Co. June 12th. (Complete.)

13,226. "Improvements in enclosed electric arc lamps." T. HAMILTON-ADAMS. June 12th.

13,243 "Improved means for ventilating electric tramcars and similar vehicles." G. H. PINDER. June 13th.

13,278. "Improvements in electric alarm and controlling apparatus." J. WERNER and J. OLSEN. June 13th.

13,281. "Improved device to be used in connection with telephone receivers." J. CAPELL. June 13th. (Complete.)

13,282. "Improved coupling device for electric motors." C. WUST-KUNZ. June 13th.

13,305. "Improvements in the brush boxes of dynamos and motors." W. H. ALLEN, SON & Co., LTD., and C. C. HAWKINS. June 13th. (Complete.)

13,310. "Improvements in apparatus adapted for indicating or automatically controlling or varying the flow of electric current." G. C. FRICKER. June 13th.

PUBLISHED SPECIFICATIONS, 1902.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

18. "Improvements connected with the trolley pillars on electric tramcars and the like." J. A. Peters and L. Peters. Dated January 1st.

53. "Improvements in or relating to electric relays or the like." P. Picard. Dated January 1st.

185. "Improvements in electric resistances." W. D. Bois-Duddell and T. Mather. Dated January 3rd.

418. "Improvements in or connected with thermo-electric batteries." B. J. Hall. Dated January 7th.

1,446. "Improvements in electrically signalling and stopping trains on railways, and apparatus for that purpose." O. Imray. Dated January 18th. (Communicated.)

1,475. "An improvement in feeder pillars for electric traction." C. Beckingsale. Dated January 20th.

17,481. "Improved liquid cement for patching cycle and motor tires, insulating electric wires and the like." E. Blundell. Dated August 8th.

18,744. "Improvements in electric controller regulators." R. Haddon. Dated August 26th.

1,961. "Improved method of heating metals in electric baths." J. Gislot. Dated January 24th.

2,065. "Improvements in or relating to driving gear for electrically-propelled vehicles." W. L. Wise. Dated January 26th. (Communicated.)

2,206. "Improvements in ladders for trimming arc lamps." G. B. Donkin and H. R. Forbes Mackay. Dated January 28th.

2,201. "Improvements in or connected with massage and electro-therapeutical apparatus." D. R. Paterson. Dated January 28th.

2,264. "Improvements in insulating compounds for conductors and the like, and in the method of applying the same." The British Thomson-Houston Co. Dated January 23rd. (Communicated.)

2,284. "Improved means of supporting and connecting electric lamps." H. H. Cooper. Dated January 28th.

2,343. "Improvements in cooling stoves heated by oil, gas, or electricity." H. J. Yates and D. R. McNeill. Dated January 29th.

2,376. "Improvements in and relating to electrolysis." H. H. Lake. (G. Rambaldini.) Dated January 29th.

2,492 "Improvements in connections for concentric electric cables." J. R. P Lunn. Dated January 30th.

2,498. "Improvements in casings for electric conductors, gas and water pipes and the like." J. D. Palmer. Dated January 30th.

2,659. "Improvements in and connected with resistance switches for electric circuits." G. Page. Dated February 1st.

2,666. "Improvements in brush-holders for dynamo-electric machines." The British Thomson-Houston Co., Ltd. Dated February 1st.

3,116. "Improvements in safety fuses for electric circuits." A. D. Smith. Dated February 7th.

3,411. "Improvements in and relating to guards for electric tramcars and the like." B. Henry & Co., Ltd., and R. B. Davidson. Dated February 11th.

3,737. "Improvements in electrical an i magnetic apparatus, such as transformers and other appliances—alloys for use therein." R. H. Hadfield. Dated February 18th.

3,819. "Improvements in and relating to storage batteries." J. T. Niblett. Dated February 14th.

3,858. "A new or improved method and means for reflecting, increasing and intensifying light from electric and other lamps, or the like." R. H. Hammond and Julia Taylor. Dated February 14th.

3,907. "Improved means of supplying energy to electric tram-cars from beneath the car." A. M. Davis. Dated February 6th.

3,914. "Improvements in electric furnaces." P. L. T. Heroult. Dated February 15th.

4,463. "An improved electric switch." H. Faraday. Dated February 21st.

4,648. "Improvements in electrical cut-outs or fuse boxes, feeder pillars and other devices for the inter-connection of a number of conductors," F. A. Pocklington. Dated February 24th.

4,783. "Improved switch for operating electric currents." F. Rawlings. Dated February 25th.

4,980. "Improvements in the galleries, holders or supports for the globes of incandescent lamps, also applicable to the globes and shades of electric, oil, and other lamps." P. H. Jancey. Dated February 27th.

5,018. "Improvements in the construction of two fluid electric batteries." J. W. Mackenzie. Dated February 27th.

4,211. "An improved manufacture or production of electrical conduits, drain pipes and the like." R. Lawton. (The Albion Clay Co., Ltd.) Dated March 1st.

5,330. "Improvements in swivelling contacts for cables used in trolleys or collectors used in connection with electrically-propelled vehicles." E. M. Munro. Dated March 4th.

5,375. "Improvements in and relating to the winding of the field magnets of dynamo-electric machines and other apparatus." F. L. Muirhead and J. Parr. Dated March 4th.

5,651. "Improvements in guard wires used in connection with electric traction trolley wires or other electric conductors." F. Smith. Dated March 7th.

5,689. "Improvements in railway points or switches." J. P. Annett. Dated March 7th.

5,907. "Improvements in the controlling of electric circuits." S. Z. de Ferranti. Dated March 11th.

6,148. "An improved thermostatic cut-out for electric heating circuits." A. Eckstein and C. H. Archer. Dated March 13th.

6,233. "Improvements in and relating to automatic electric circuit-breakers." S. Z. de Ferranti. Dated March 13th.

The Electrical Review

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LONDON: PUBLISHING OFFICE, 4, LUDGATE HILL, E.C. Subscription per annum, Postage inclusive, in Great Britain, 19s. 6d.: to all other Countries, 30s.—New York: D. Van Nostrand, 23, Murray Street and 27, Warren Street. Paris: Madame Veuve J. Boyveau, Librairie Etrangère, 22, Rue de la Banque. Berlin: A. Asher and Co., 13, Unter den Linden.

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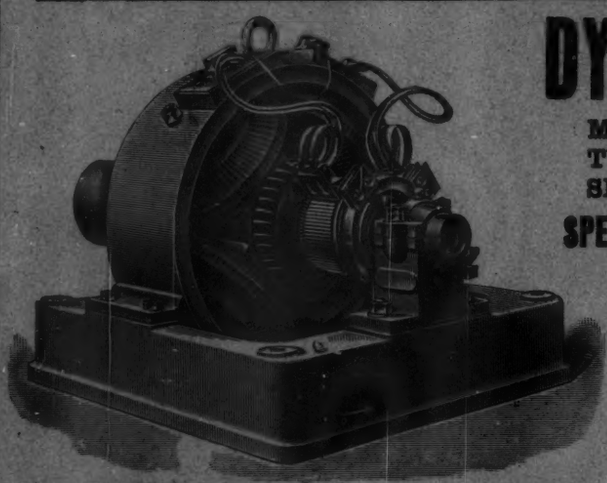

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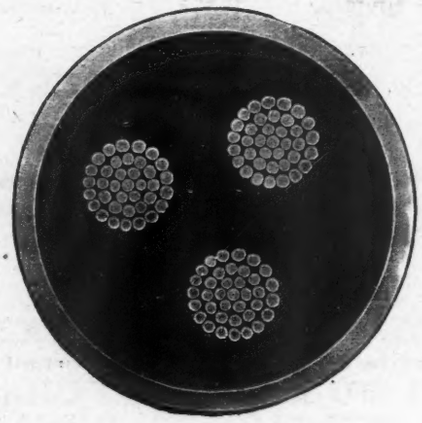

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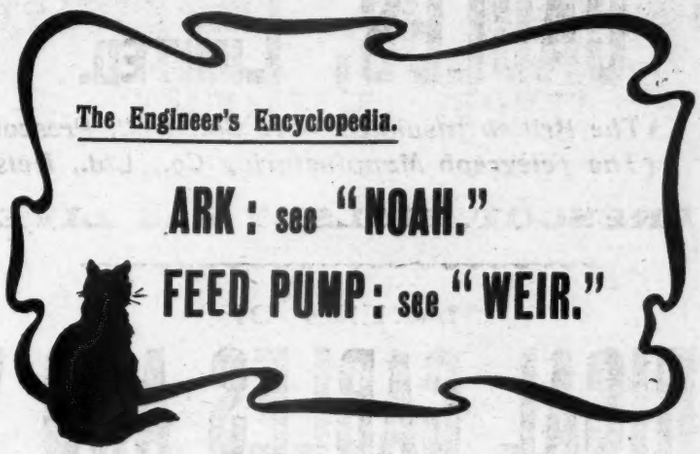

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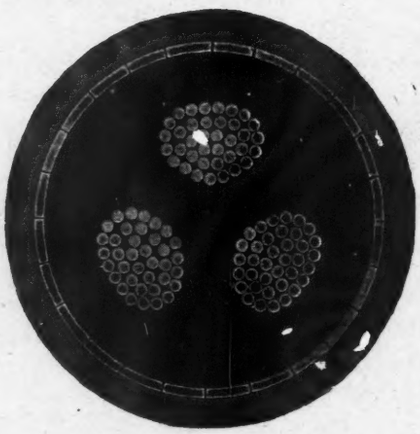

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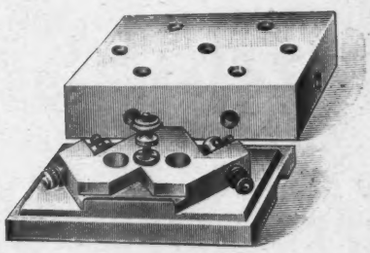

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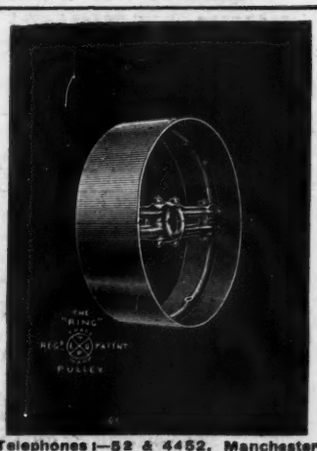

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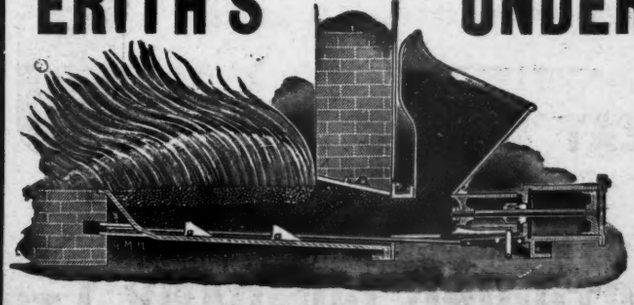

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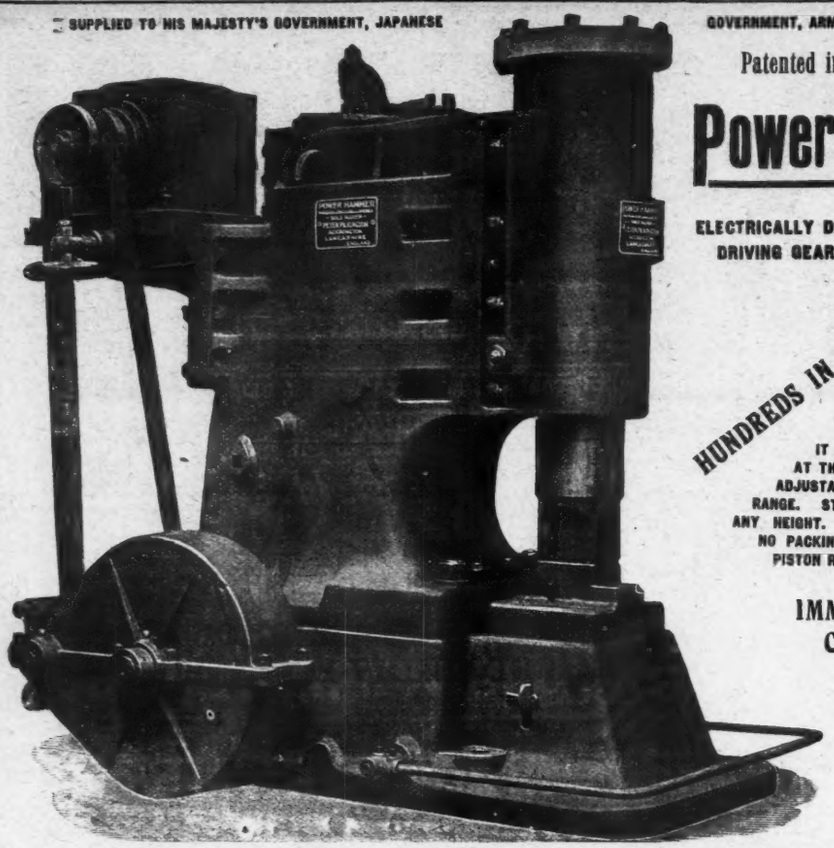

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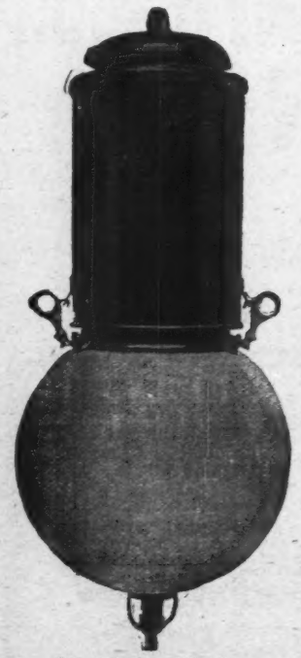

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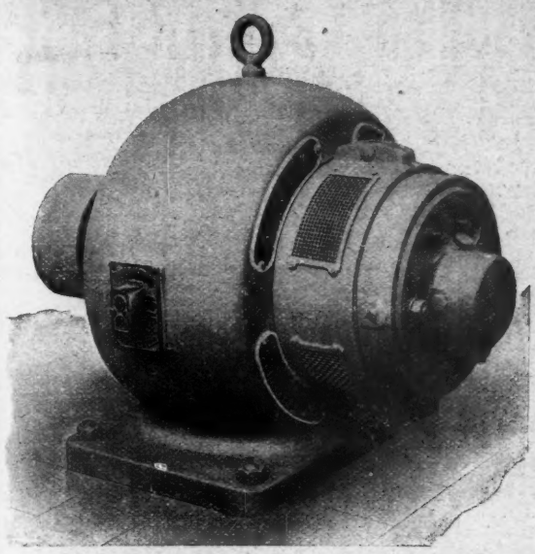

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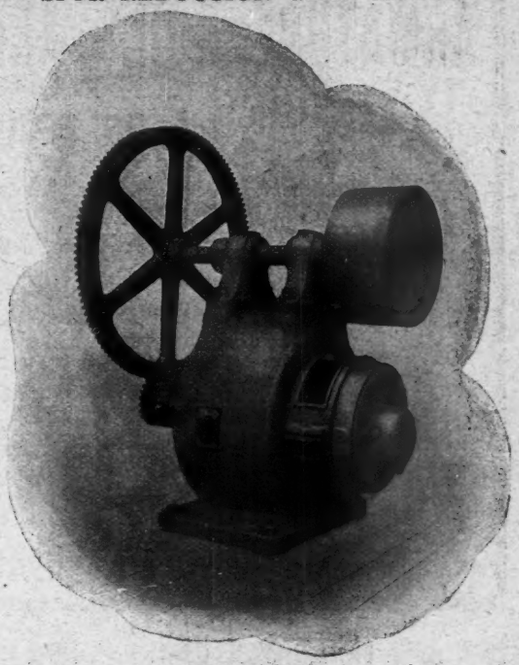

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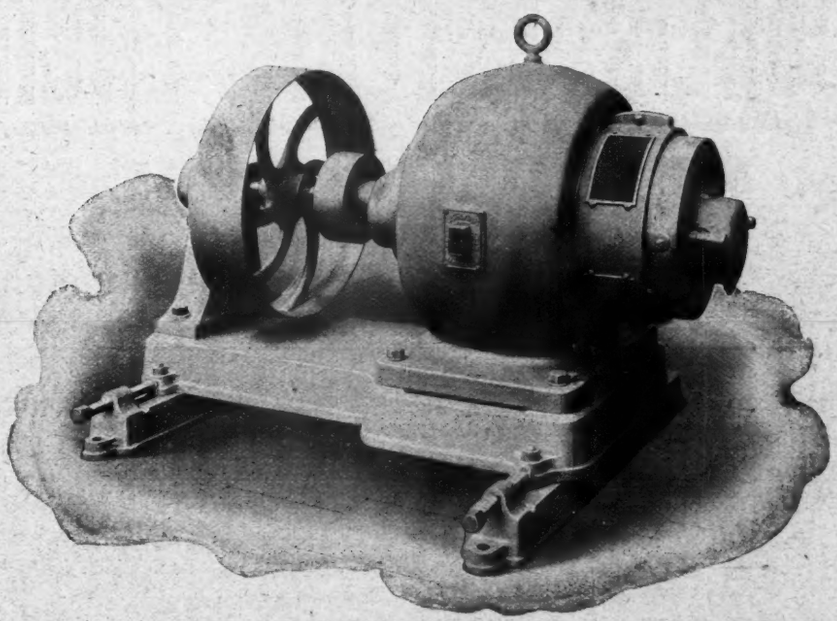

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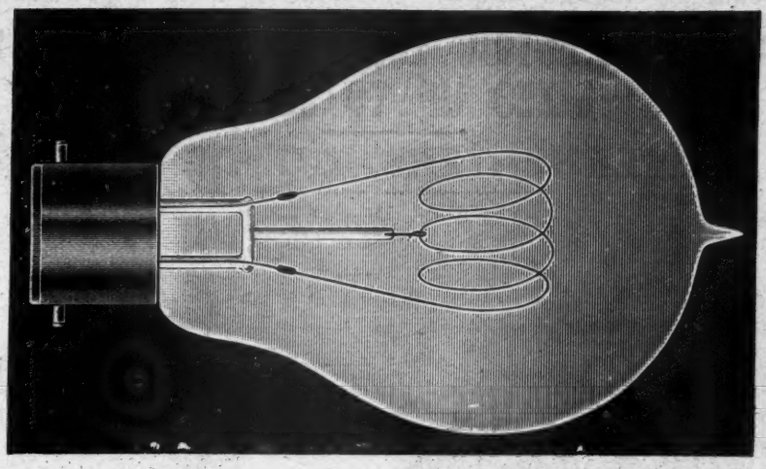

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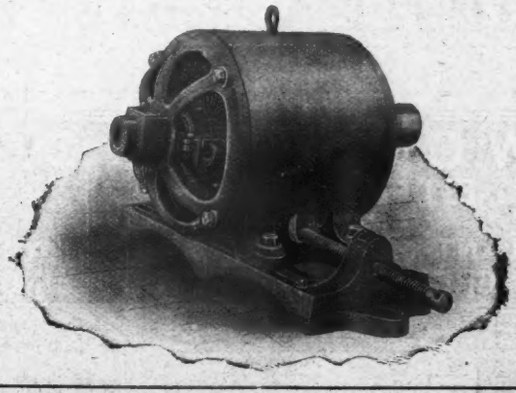

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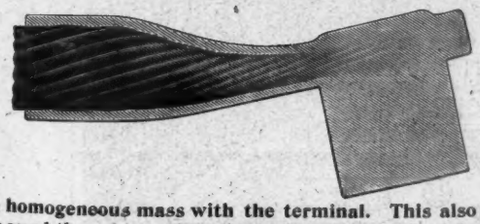

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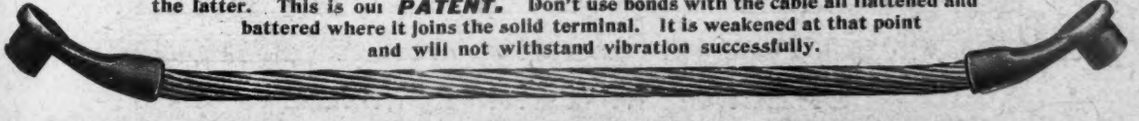

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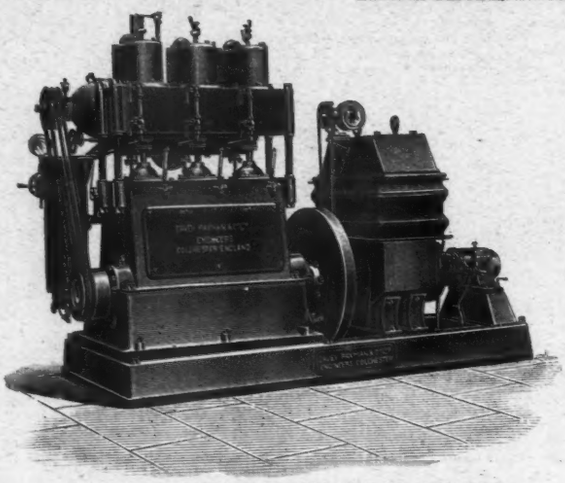

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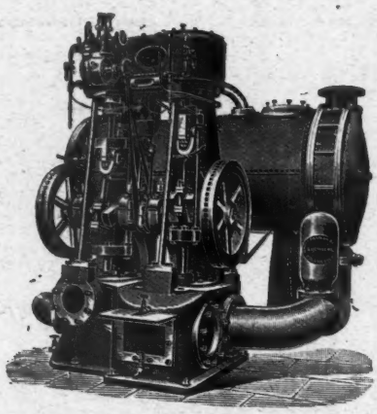

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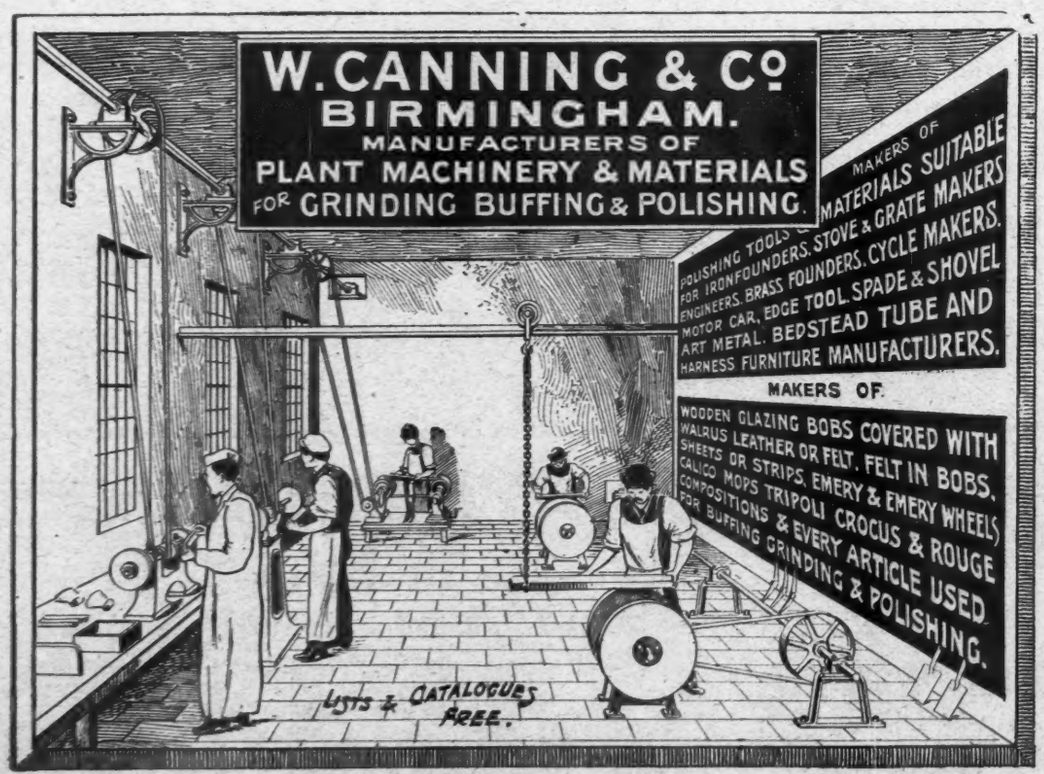
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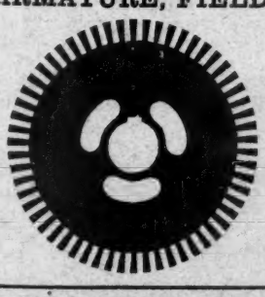

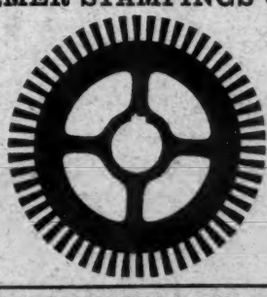

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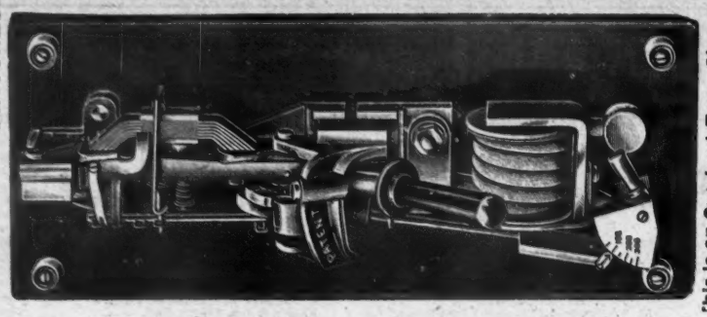

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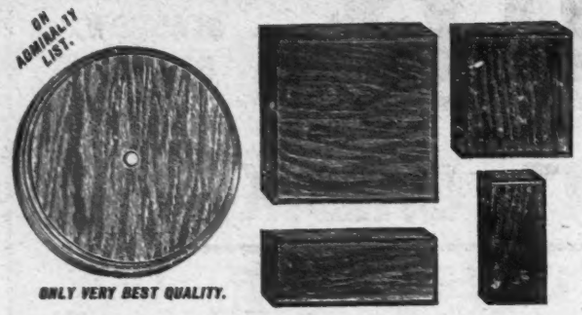

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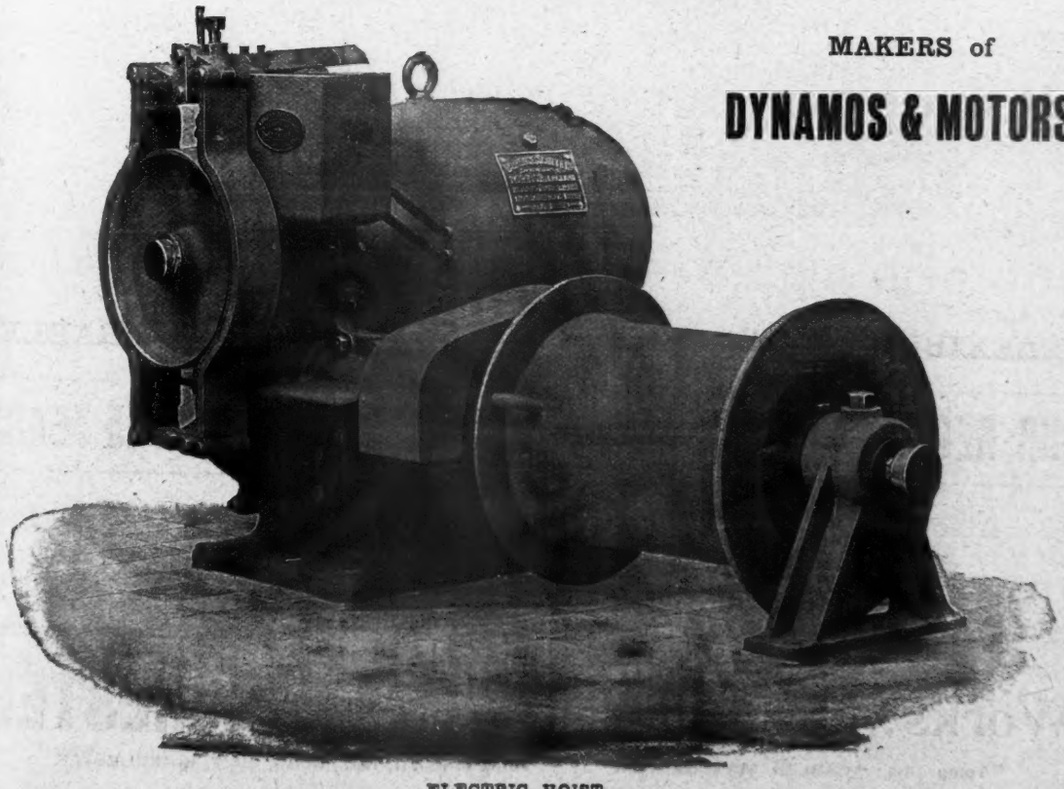

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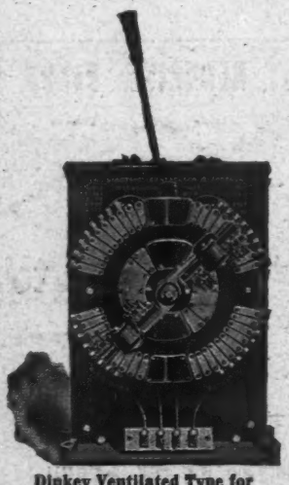

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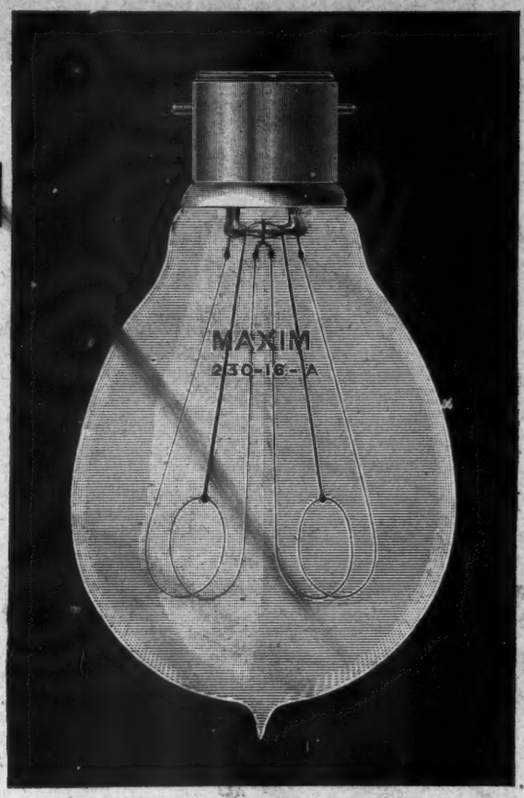

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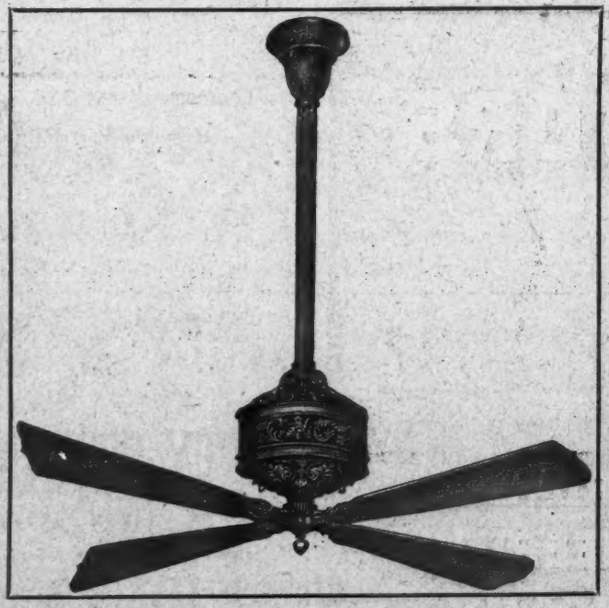

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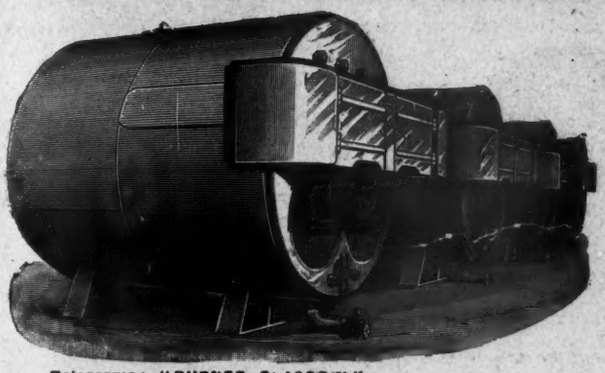

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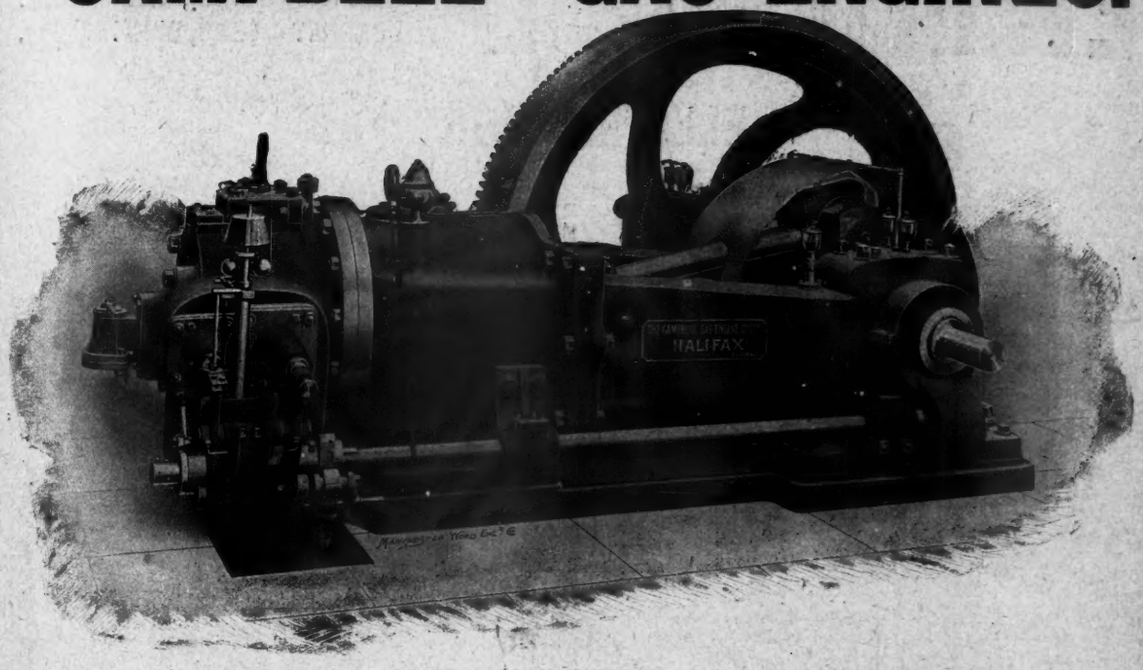


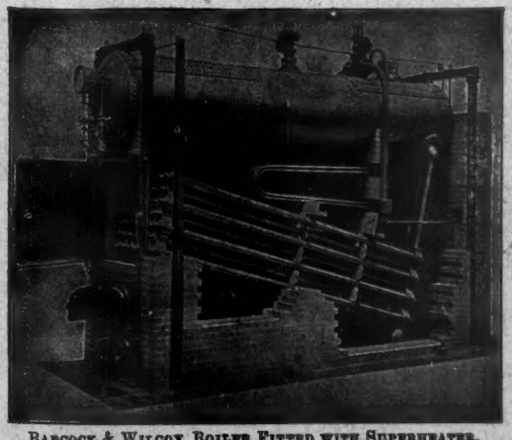
160 Brake-H.P. PRODUCER GAS ENGINE.

The Engine illustrated is fitted with Water-Cooled Piston and Exhaust Valve.

THE CAMPBELL GAS ENGINE CO., Ltd.

HALIFAX, ENGLAND.

London Office:—114, Tooley Street, S.E.; Glasgow Office:—104, Bath Street.



BABCOCK & WILCOX BOILER FITTED WITH SUPERHEATER.

BABCOCK & WILCOX LTD.,

PATENT WATER-TUBE

SAFETY STEAM BOILERS

OVER **3,900,000 H.P.** IN USE,

1,000,000 H.P. of which are installed in

Electric Light & Traction Stations.

200 Plants equipped in Great Britain and Ireland alone.

COMPLETE STEAM PIPING INSTALLATIONS AND ALL BOILER HOUSE ACCESSORIES.

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Works:—RENFREW, SCOTLAND.

TRADE MARK.

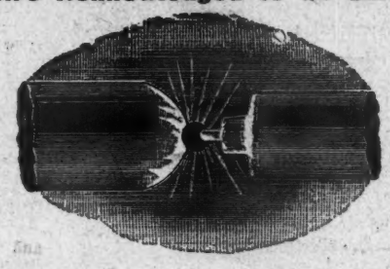
SCHIFF & CO.'S

Arc Lamp Carbons for OPEN and ENCLOSED Types

Are Acknowledged to be among the Best in the Market

TRADE MARK.

The G quality is made for a consumption of from ¾ in. to 1 in. per pair per hour, and our W and A Alternating and Enclosed Arc Lamp Carbons are not surpassed for light and absence of ash.



The "SHIP" Carbons take a less number of Watts per candle-power without diminution of the Arc than those of other makers.

FOR PRICES APPLY TO—

DE GRELLE, HOUDRET & CO., ELECTRICAL AND MECHANICAL ENGINEERS,
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Sole Agents for Schiff & Co.'s "Ship" Carbons.

Telephone: London Wall 1868. Telegraphic Address: "DEGRELLE, LONDON."

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ELECTRIC LIGHT

=Fittings=

To Suit all Styles of Decoration.

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A NEW CATALOGUE READY IN APRIL

Manufacturers of Everything in Connection with the Electrical Trade.

THE TRADE ONLY SUPPLIED.

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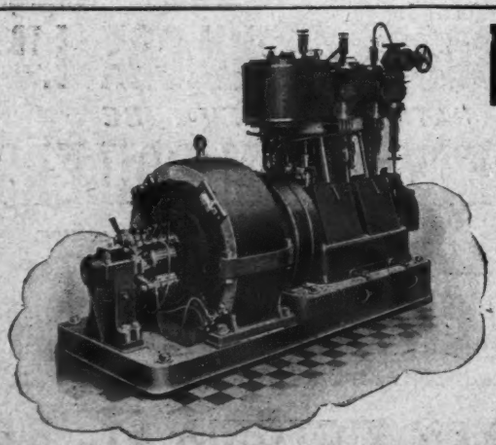
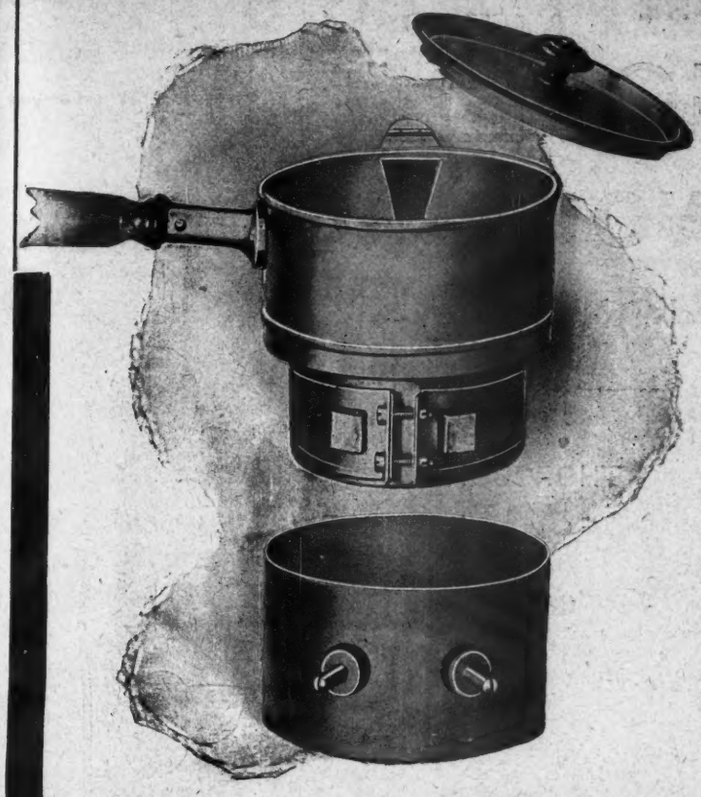


Standard Generator coupled to Open Type Compound Engine.

McCLURE & WHITFIELD, STOCKPORT.

MERSEY DYNAMOS and MOTORS.

Telegraphic Address:—"MOTORS, STOCKPORT.
Telephone No. 180.



"Prometheus"

ELECTRICAL COOKING AND HEATING

Apparatus

THE illustration shows our No. 4a Hot Water Jug with bottom part removed and Patent Ring Element in position. Practically the whole of the heat generated passes at once into the contents of the vessel. THE EFFICIENCY of all apparatus is extremely high, and the various utensils are guaranteed for a period of 12 months from date of leaving works.

THE ONLY STRIP SYSTEM MANUFACTURED.

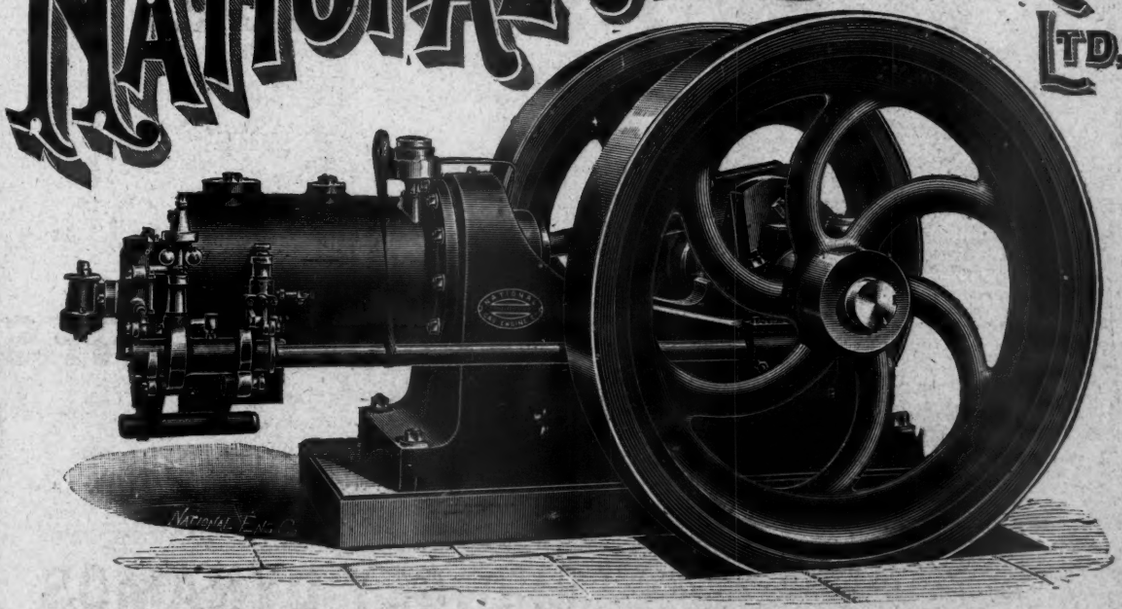
Most Complete and Most Efficient System on the Market.

FULL PARTICULARS FROM THE

British Prometheus Co., LTD.,
18, LONDON ROAD,
Kingston-on-Thames.

SOMETHING NEW and RELIABLE.

THE NATIONAL GAS ENGINE CO. LTD.



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Works and Head Offices: ASHTON-under-LYNE, MANCHESTER.

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THE

"BOTHCALL"

DIRECT-WORKING

TELEPHONES.

DESK SET.
30/-

THOROUGHLY RELIABLE.

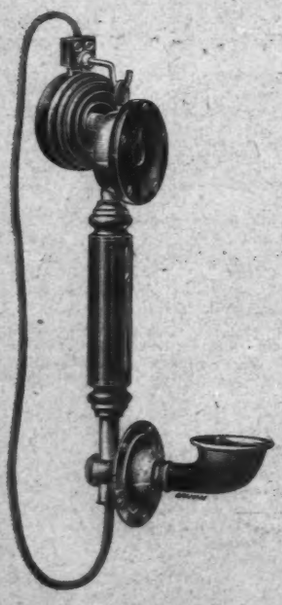
GOOD WORKMANSHIP.

EFFICIENT.

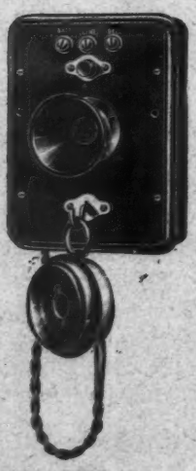
WALL SET.
24/-

TWO GOOD LINES.

BRITISH MADE.



THE "PORTABLE."
18/-



THE "KITCHEN."
10/6

THE

"GEEKO"

TELEPHONES

FOR CONNECTING TO EXISTING ELECTRIC BELL WIRES.

THE

GENERAL ELECTRIC CO., LTD.

71, Queen Victoria Street, LONDON, E.C.

And at MANCHESTER. GLASGOW. BIRMINGHAM. NEWCASTLE. DUBLIN and CARDIFF.

WHEATLEY KIRK, PRICE & CO.

(ESTABLISHED 1880),

ELECTRICAL & MECHANICAL VALUERS, ARBITRATORS AND AUCTIONEERS.

Our Average Annual Valuations Exceed £2,000,000.

TRAMWAY AND ELECTRICITY SUPPLY VALUATIONS.

Periodical Valuations, Stocktakings and Reports for DEPRECIATION, RENEWALS, &c., in conformity with the Acts.

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And at Albert Chambers, Albert Square, Manchester.

Telephones:—5077 Bank, London. 3218 Central Manchester.

Telegraph Addresses:—"Indices, London." "Indicator, Manchester."

SITUATIONS VACANT.

If letters are not to be delivered to certain firms or individuals (if known), instructions to that effect should be sent to the Manager of the ELECTRICAL REVIEW, who will do his best to carry out such instructions. Letters of applicants cannot in such cases be returned to them, nor can the names of Advertisers using a number or a *nom de plume* in any way be disclosed.

Original Testimonials should never be sent.

THE MUNICIPAL CORPORATION OF PORT ELIZABETH.

Appointment of Electric Lighting Engineer.

THE undersigned are, by cable, authorised to receive from gentlemen, not over 40 years of age, applications in detail for the above appointment.

The candidates must be qualified and capable to (*a*) design a scheme for the lighting of the town and the supply of electricity for private purposes; (*b*) supervise the installation of the whole plant; (*c*) act as Resident Municipal Electrical Engineer, discharging such duties as are usual in similar appointments under a British Corporation.

The officer appointed will be required to devote the whole of his time to the duties of the office, and to enter into an agreement to remain in the service of the Corporation for a period of not less than three years.

The salary to be paid is, for the first year, £600, and rising by annual increments of £50 to £750.

The Corporation will supply the officer appointed with a first-class passage from London to Port Elizabeth.

Canvassing, personally or otherwise, whether in London, the Provinces, or Port Elizabeth, will disqualify any candidate.

There is no special form of application; but each candidate is required, in addition to his professional status and his age last birthday, to set out in detail where he was educated, to whom he was articled, the appointments he has held (and these in chronological order), and to enclose copies (not originals) of not more than six testimonials of recent date.

The above applications must be deposited at the offices of the undersigned not later than noon on THURSDAY, JULY 9th next.

DAVIS & SOPER,
Agents of the Municipal Corporation of Port Elizabeth.

54, St. Mary Axe, London, E.C.,
June 24th, 1903. 2800

ALDERSHOT URBAN DISTRICT COUNCIL.

Electrical Engineer.

THE ABOVE-NAMED COUNCIL require the services of a competent Electrical Engineer to manage their Supply Station.

Applicants must be familiar with the three-wire continuous current system with batteries; and the person chosen must devote the whole of his time to the duties of the Council.

Salary, £200 per annum, rising by annual increments of £20 to £260 maximum.

Applications, stating age and general experience, together with copies of two recent testimonials, should be forwarded in a sealed envelope, endorsed "Electrical Engineer," to the Clerk of the Council, not later than Wednesday, July 8th, 1903.

Canvassing, personal or otherwise, will disqualify.

By Order of the Council,
W. E. FOSTER,
Clerk.

Council Offices, Aldershot,
June 17th, 1903. 2782

NEWCASTLE-UNDER-LYME.

Electric Clerk of Works.

THE GAS AND ELECTRIC SUPPLY COMMITTEE are prepared to receive applications for the above position. Applicants must have had experience in the working of a direct current central station, with batteries, distribution, and also the laying of cables, services, &c., and all necessary testing, &c. The salary proposed is £150 per annum, and the committee reserve the right to retain his services as engineer or works manager on the completion of the installation.

Applications, stating age, experience, and enclosing not more than three recent testimonials, to be sent in on or before July 4th next, endorsed "Electrical Clerk of Works," Town Clerk.

By order,
W. WINSTANLEY. 2770

SITUATIONS VACANT.—*Continued.*

COUNTY BOROUGH OF HALIFAX.

Technical Instruction Committee.

APPLICATIONS are invited for the post of First Assistant in the mechanical and electrical engineering department at the commencing salary of £150 per annum.

Candidates must state that they have read the printed particulars, which can be obtained on application to the Principal, Municipal Technical School, Halifax.

Applications must be sent to the Principal not later than JUNE 30th, 1903. 2561

CITY OF MELBOURNE.

Appointment of Assistant Electrical Engineer.

APPLICATIONS are hereby invited for the position of Assistant Electrical Engineer to the Council of the City of Melbourne, at a minimum salary of £300 per annum, increasing by annual increments of £25 (subject to the recommendation of the Electric Supply Committee) to a maximum of £450.

Applicants, who must not be more than 35 years of age, are required to state their age and experience, and to furnish testimonials as to qualifications and competency.

The person appointed will be required to devote the whole of his services to the City Council, and other professional engagements will not be permitted.

The person chosen for the appointment must be prepared to insure his life for £450 in accordance with the Corporation Service Regulations.

Applications for the appointment must be endorsed "Application for Appointment of Assistant Electrical Engineer, Melbourne," and sent in on or before the 6th day of JULY, 1903, addressed to the Acting Agent-General for Victoria, 142, Queen Victoria Street, London, E.C., from whom (on personal application) all information as to the duties and conditions of appointment can be obtained.

JOHN CLAYTON,
Town Clerk.

Town Clerk's Office,
Town Hall, Melbourne,
May 5th, 1903. 2699

SHANGHAI MUNICIPAL COUNCIL.

Electricity Department.

THE COUNCIL for the Foreign Community of Shanghai require the services of a Senior and a Junior Engineer-in-Charge for their generating station.

Salaries: taels 200 and 175 per month respectively, equal at present rate of exchange to £280 and £245 per annum, with quarters, fuel, and light, and participation in superannuation fund.

Applicants must have had experience in a high-tension alternating current station containing at least 1500 KW. of plant.

They must be fully qualified and competent to perform the usual duties of an engineer-in-charge, besides which the testing of meters and arc lamps will be amongst their duties.

Preference will be given to candidates having also had experience with alternate current motor generators and secondary storage batteries.

Candidates must be unmarried, and pass a medical examination, age not less than 25 for the senior and 24 for the junior. Agreement in the first instance for three years. They will be required to leave this country by the end of July.

First-class passage out and liberal leave rules. Half salary while on voyage. Further particulars may be obtained from the Council's London Agents, Messrs. JOHN POOK & Co., 63, Leadenhall Street, E.C., to whom all applications, accompanied by a statement as to experience, and not more than three testimonials, must be forwarded not later than MONDAY, JULY 6th, 1903. 2795

BOROUGH OF TORQUAY.

ELECTRICITY DEPARTMENT.

Appointment of Assistant Engineer for High-tension Alternating Station.

THE CORPORATION OF TORQUAY invites applications for the position of Assistant Electrical Engineer at a salary of £156 per annum.

Particulars of duties may be obtained of the undersigned.

Applications, which must be made on forms provided by the Corporation, must reach me not later than 3.30 p.m., on Monday, the 20th July, 1903, endorsed "Assistant Electrical Engineer."

FREDK. S. HEX,
Town Clerk.

Town Hall, Torquay,
June 18th, 1903. 2772

(Continued on next page.)

SITUATIONS VACANT.—*Continued.*

TO ENGINEERS.

WANTED at the North-Western Fever Hospital, Lawn Road, Hampstead, N.W. (under the Metropolitan Asylums Board), a thoroughly experienced Engineer.

Wages 50s. per week, with board, lodging, washing and uniform (subject to statutory deduction under the provisions of the Poor Law Officers' Superannuation Act, 1896).

Candidates must produce satisfactory evidence of competency, and be able to take charge of the boilers, engines, electric light apparatus, and the lamps and connections therewith. Accommodation is provided only for a single man.

Forms of Application can be obtained at the Office of the Board, Embankment, E.C., where such forms, duly filled up and accompanied by copies of three testimonials and certificates of recent date, must be delivered by 10 a.m. on Monday, July 6th, 1903.

June 19th, 1903. 2780

MIDDLESEX EDUCATION COMMITTEE.

Finchley Local Committee.

THE above Committee require the services of a Teacher of Electric Lighting and Electric Wiring, for lessons of 2½ hours' duration, on one evening per week, during the Session 1903-4.

Applications, stating age, qualifications, experience and salary required per lesson, to be sent to Mr. B. S. Gott, Guildhall, Westminster, S.W., before the 7th July, 1903. 2863

HACKNEY INSTITUTE.

THE GOVERNORS are prepared to receive Applications for the Appointment of Lecturer in Physics and Electrical Engineering. Salary to commence at £250 per annum. The Lecturer will be head of his department, and will be required to give his whole time to the work of the Institute.

Applications must be sent in on or before July 1st on forms to be obtained from the Hon. Clerk to the Governors, Hackney Institute, Dalston Lane, N.E. 2674

WANTED for a large Electro-technical Institute, an Electrical Engineer with technical college training and not less than 5 years' practical experience, and, preferably, some knowledge of the art of teaching. The position would take the entire time and attention of the applicant. Candidates are requested to give fullest particulars regarding previous training, experience, age, &c., and salary expected.—Address, 2713, Electrical Review, 4, Ludgate Hill, London. 2713

Where Advertisements are to be answered to a given number, letter, or *nom de plume* at the Electrical Review Office, applications for names and addresses of the Advertisers will be entirely disregarded.

Cheap prepaid Advertisements are inserted under this heading at the rate of One Penny Per Word (minimum 1s.). Three Consecutive Insertions for the price of two.

Box Number and Electrical Review address count as seven words.

A.—Electrical and engineering and motor firms have Vacancies in London and country works for young gentlemen to train for permanent appointments, as Pupils. Ages 15 to 25. Premium required, £50 and upwards.—For application forms with particulars, address, Box R., Tayler's, 154, Fleet Street, E.C. 2673

ADDITIONAL Estimating Assistant.—Glovers, Trafford Park, Manchester. 2705

AN electrical installation contracting company is in want of a General Foreman with good all round experience. Preference given to one willing to take shares in the company.—2763, Electrical Review, 4, Ludgate Hill, London. 2763

CANVASSER wanted temporarily, accustomed to soliciting orders for electric lighting, bells, telephones, &c.—Apply, stating experience, wages required, &c., to 2845, Electrical Review, 4, Ludgate Hill, London. 2845

DRAUGHTSMAN Wanted, fully conversant with all details in connection with car bodies and trucks for electric tramways.—Apply by letter, stating previous experience and salary required, to Cars, 4, Adelphi Terrace, London, W.C. 2805

DRAUGHTSMAN wanted, one experienced in switchboard work preferred.—Apply, stating age, experience, and salary required to 2767, Electrical Review, 4, Ludgate Hill, London. 2767

DRAUGHTSMAN wanted in Yorkshire, experienced in direct current motors and generators; knowledge of switch work an advantage.—State age, experience and salary, to 2814, Electrical Review, 4, Ludgate Hill, London. 2814

DRAUGHTSMAN, young, wanted at once.—One used to switchboard work and with good electrical knowledge preferred.—State age, salary and experience to 2558, Electrical Review, 4, Ludgate Hill, London. 2558

DRAUGHTSMEN required by large electrical manufacturing firm in Midlands, used to switchboards, dynamos or steam engines.—State age, experience, salary, and how soon able to commence duties, to 2823, Electrical Review, 4, Ludgate Hill, London. 2823

SITUATIONS VACANT.—*Continued.*

ELECTRIC Lighting. — Experienced Energetic Engineer wanted by Scottish manufacturing firm to take charge of electrical department. Must have practical and commercial experience in light and power work, thoroughly conversant with estimating, buying and office routine, capable of interviewing clients, superintending contracts and controlling workmen.—Address, with full particulars of experience, stating age and salary expected, No. 72, Keith & Co., 43, George Street, Edinburgh. 2826

ELECTRICAL Engineering Pupil required. Thorough practical training in the manufacture of electrical machinery and apparatus.—For particulars and premium write "F. O.," Box 875, Willing's, 125, Strand, W.C. 2804

ELECTRICAL Fitter. — Wanted a thoroughly experienced Electrical Fitter to take charge of lighting and power plants, capable of keeping motors and leads in good order, making extensions and wiring up cranes in course of manufacture.—Apply, stating age, experience, wages required, and names of recent employers, to 2766, Electrical Review, 4, Ludgate Hill, London. 2766

ENERGETIC Salesman wanted by wholesale electrical firm in London, to take charge of forwarding. Apply with copies of testimonials.—2803, Electrical Review, 4, Ludgate Hill, London. 2803

ELECTRICAL Mechanic wanted, London; young man for making small power motors and transformers. State age, wages, and experience. Also a smart Improver.—2544, Electrical Review, 4, Ludgate Hill, London. 2544

ELECTRICAL Trades Union, reg. No. 640, telephone No. 623 Central.—Employers requiring competent workmen can obtain same at short notice by the use of the telephone or post, to A. Ewer, Club Union Buildings, Clerkenwell Road, E.C. 9791

ESTIMATING Assistant, age about 21, shorthand, typewriting. State salary expected.—2859, Electrical Review, 4, Ludgate Hill, London. 2859

ESTIMATING Clerk wanted for switchboard work, with knowledge of drawing preferred. State age, experience and salary required.—Tucker & Co., Sampson Road North, Birmingham. 2584

FITTER required, must be accustomed to steam pipe work and quick revolution engines. Permanent post to the right man. 2857—Electrical Review, 4, Ludgate Hill, London. 2857

JUNIOR Assistant, with theoretical and mechanical training, and with experience in working central station switchboard, direct-current three-wire system with batteries. Salary £52 per annum to commence.—Apply, stating age and experience, with testimonials, not later than Wednesday, July 1st, to G. D. Long, Resident Engineer, Electricity Works, Grays, Essex. 2788

PREMIUM Pupil.—Vacancy occurs shortly in municipal power and lighting station to qualify for assistant engineer.—Apply 2821, Electrical Review, 4, Ludgate Hill, London. 2821

PUPIL.—An electricity supply company (alternating system) have a vacancy for a Pupil. Premium £50. State age and previous training to Manager, 2831, Electrical Review, 4, Ludgate Hill, London. 2831

PUPIL wanted in electrical laboratory in London. Premium 50 guineas. Good opening for smart young man.—2658, Electrical Review, 4, Ludgate Hill, London. 2658

RESPECTABLE Woman wanted to take charge of coil-winding department. Must be thoroughly experienced in all classes of telephone and telegraph work.—Apply stating age, experience, and wages required, to Telephone Works, Beeston, Notts. 2824

SWITCHBOARD Attendant, used to three-wire direct-current system, required immediately. Salary 20s. per week. Applications with copies of testimonials to Northwich Electric Supply Co, 25, Castle Street, Northwich. 2791

SWITCHBOARD Attendant wanted, used to three-wire system and batteries, wages 25s. per week.—Apply, Wright, Electricity Works, Rhyl. 2873

THANKS are tendered to the applicants who applied for the position of Improver at the Corporation Electricity Works, Stockton-on-Tees, the vacancy having now been filled. 2769

TO PARENTS and Guardians.—Vacancy for educated youth about 16, to train with large firm of wiring contractors. Electric lighting and power, &c. Board and residence.—For particulars apply 2864, Electrical Review, 4, Ludgate Hill, London. 2864

TO Parents and Guardians.—Vacancy for well-educated Youth to train for Cable Co.'s or Marconi wireless telegraph system. Small premium. Board and residence if required.—Write Wireless, care of Streachan's, 149, Strand. 2581

TRAVELLER wanted for electrical machinery (dynamos, motors, switchboards, &c.), for London district. Salary and commission. Only first-class men with good connections and knowledge of the business need apply. State terms, references, and past employment to "X. V. Z.," c/o Streets, 30, Cornhill. 2765

TRAVELLER and Correspondent wanted immediately by manufacturers of electrical accessories and conduit; good opportunity for energetic and conscientious man.—Address with references 2816, Electrical Review, 4, Ludgate Hill, London. 2816

(Continued on next page.)

SITUATIONS VACANT.—*Continued.*

VACANCY for an Improver. Special testing work. Premium 50 Guineas. State age and training.—2822, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 2822

WANTED Assistant in production department of electrical manufacturing company in the Midlands. Smart pushing man with office and workshop experience.—Apply stating age, salary required, and when free, to 2819, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 2819

WANTED for India, a young Electrical Engineer as assistant. Must have had good experience in lighting, fan, and motor work.—Apply 2802, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 2802

WANTED.—Working Foreman Electrician, capable of starting and repairing generators, motors and wiring for continuous and three-phase currents. Bell men and linguists need not apply.—Applications to state age, experience, wages required and references, which will be treated as "confidential."—2790, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 2790

WANTED, at a central station in the North, a Foreman Engineer, to take charge of the generating plant. Applicants must have had experience with high-speed steam engines; someone with an electrical knowledge preferred.—Send particulars of experience and salary required, with testimonials, to 2697, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 2697

WANTED, by leading arc lamp manufacturing company, thoroughly experienced Travellers, with good connection with the trade, to push the sale of arc lamps. Liberal commission offered to competent persons.—Send full particulars with references to 2796, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 2796

WANTED, Shift Engineer to take charge of an eight-hour shift in a combined alternating and direct-current station. Applicants must state present occupation, salary required, age, and experience, and how soon they could commence duty, enclosing copies of recent testimonials, to be forwarded before July 7th, to 2810, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 2810

WANTED, a Draughtsman for an electricity works near London. One accustomed to mechanical drawing preferred. Wages 35s. to 40s. per week.—2813, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 2813

WANTED, in the commercial department of a large firm of electrical engineers in London, gentleman to take charge of correspondence and advertising. Knowledge of auditing preferred, and must have a thorough knowledge of the trade. Only experienced men need apply.—State experience, age, and salary required to THE LAHMEYER ELECTRICAL CO., LTD., 109-111, New Oxford Street, London, W.C. 2806

WANTED.—Works Superintendent; must be capable of handling factory making variety of electrical work, and great importance will be attached to the rapid and correct execution of orders. — 2852, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 2852

WANTED, a thoroughly competent Telephone Inspector for test room. Must be well experienced in testing and passing receivers, transmitters, and similar apparatus. Write giving age, experience, and wages required to Telephone Department, General Electric Co., Peel Works, Salford. 2860

WANTED, good Mechanical Draughtsman for firm in Yorkshire.—Apply stating age, experience, and salary required to 2855, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 2855

WANTED, a competent man to take charge of cables, extensions, service connections and outside work generally; must be a capable jointer used to lead covered paper cables.—Apply to the undersigned, stating age, experience and pay required.—C. FRED MCINNES, Electricity Works, Gravesend. 2851

WANTED.—Storage Battery Hand. Must be experienced in lead casting and burning.—State wages, &c., to 2874, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 2874

WANTED, Mechanic, accustomed to testing and adjusting arc lamps.—Apply stating age, experience, and salary required to 2616, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 2616

SITUATIONS WANTED.

Where Advertisements are to be answered to a given number, letter, or *nom de plume* at the ELECTRICAL REVIEW Office, applications for names and addresses of the Advertisers will be entirely disregarded.

Cheap Prepaid Advertisements are inserted under this heading at the rate of One Penny Per Word (minimum 1s.). Three Consecutive Insertions for the price of two.

Box Number and ELECTRICAL REVIEW address count as seven words.

ABLE, energetic Manager, thoroughly experienced, practically, technically and commercially, with all classes of installation work, requires responsible position. Splendid testimonials.—"W.," 101, Acton Lane, Acton Green. 2849

ADVERTISER (Englishman) with over 10 years' experience in electrical trade (commercial and manufacturing) having thorough knowledge of German and French, desires position of trust; good organiser and manager.—2853, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 2853

ADVERTISER requires post as Canvasser to supply company or contractors.—Address, 2817, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 2817

SITUATIONS WANTED.—*Continued.*

ADVERTISER (17), desires berth on lighting plant, or other suitable employment, 1½ years' experience, drawing office, workshops, lighting and installations.—Box 2613, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 2613

ADVERTISER, with considerable practical experience, in electric power, lighting, &c., motor car repairing, canvassing, buying, getting out quantities, would like to hear from any firm about taking up same.—2588, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 2588

ADVERTISER seeks situation, charge of plant, good all-round experience with engines, dynamos, house lighting, &c.; own repairs, good refs.—"RUNGAY," Myrtle Road, Hampton Hill. 2739

AS Foreman or Jointer; experienced, concentric, armoured, solid and paper cables.—"H. G.," 76, Commercial Road, Grantham. 2553

AS Manager of Branch Electrical Business, advertiser (29) with 11 years' experience in all kinds of electrical work, requires situation as above, 5 years' experience estimating, sub-contracting, interviewing, canvassing, &c.; highest references.—2850, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 2850

AS Secretary or Assistant in London, 10 years' practical and commercial experience of supply and contracting work; estimating, correspondence, shorthand.—2871, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 2871

A YOUNG Engineer (22), with five years' good mechanical and electrical training, desires situation with a firm or station as junior. Small salary in lieu of good prospects.—2799, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 2799

CERTIFIED Electrical Engineer (27 years), well up in the design of all electric machinery, American and Continental practice, speaking English, French and German, wishes responsible position.—Write to 2633, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 2633

CLERK (23) requires engagement, thorough knowledge of the electrical trade, experienced in estimating, interviewing, and management of men, good references.—"H. C.," 181, High Street, Southampton. 2861

COMPETENT Wireman, lighting, telephones, bells, casing, simplex.—13, Nynehead Street, New Cross, S.E. 2828

ELECTRICAL Engineer (30), good general and contracting experience, interviewing, estimating and erection of plant, moderate salary.—2789, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 2789

ELECTRICAL Engineer (thoroughly competent) desires change, plant or otherwise; first-class credentials; age 30.—"E. C.," 47, Cranmer Road, Brixton. 2870

ELECTRICAL Engineer, A.M.I.E.E., desires appointment. Thorough practical and commercial experience.—Address 2568, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 2568

ELECTRICIAN (24) wants job; own casing, Simplex, barrel, bells and telephones, references.—FOSTER, Eton Street, Richmond, Surrey. 2686

ELECTRICIAN, competent Wireman, all-round, wants job or charge; excellent references.—2748, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 2748

ELECTRICIAN (age 22) disengaged; light, bells, telephones; good refs.—SUTTON, Laburnum Road, Epsom. 2737

ELECTRICIAN - Wireman requires situation, experienced in Simplex, casing, and lead covered.—FRITCHE, 21, Borough Road, Birkenhead. 2811

ELECTRICIAN, with 10 years' practical experience, desires post in London station.—2809, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 2809

ENGINE-DRIVER or Handyman requires situation; well up in all classes of engines and boilers, electric plants, motors, smithing, pipework, and repairs. Town or country. First-class references.—"FITTER," 72, Barry Road, Stonebridge Park, N.W. 2620

ENGINEER, experienced in design of direct current and polyphase distribution systems is desirous of employing spare time in the evening working for consulting engineers or contractors.—2722, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 2722

ENGINE Fitter (26), eight years' experience shop and central station, charge of plant or otherwise, country preferred.—"A. B.," 4, Bearton Road, Hitchin, Herts. 2586

ESTATE.—Young Man, experienced, seeks permanent situation to run electric plant, &c. Write particulars.—2786, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 2786

EXPERIENCED all-round wireman seeks employment, town or country.—2835, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 2835

(Continued on next page.)

SITUATIONS WANTED.—*Continued.*

FITTER-DRIVER, with tramway experience, seeks situation.—2723, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 2723

FOREMAN Wireman (31), interior and street lighting, thoroughly efficient with Brockie-Pell lamps.—"J. T.," 145, Penwith Road, Earlsfield, London. 2707

HANDYMAN seeks sit. to attend gas or steam lighting plant. Good refs.—"B.," 22, Kendoa Road, Clapham. 2814

JOINTER, concentric, own plumbing; good all round.—J. WATLING, Dunwich, Saxmundham, Suffolk. 2818

M.I.E.E. is open to engagement as Chief Engineer or Manager of a traction and mining department with electrical contracting and manufacturing concern or consulting engineer. First class experience in three-phase traction and mining installations, also in the colonies.—2777, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 2777

PRIVATE Plant.—Electrician, with 15 years' experience, seeks situation in the fitting of above. Can fix own engines. First-class testimonials.—2865, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 2865

THE Advertiser, with 16 years' experience in Cable and Wire manufacture, seeks a position as Chief Foreman, he has a thorough knowledge of vulcanised bitumen, impregnated paper or fibre cables, and vulcanised rubber cables, and is in possession of all the mixtures and compounds required in a cable works.—2768, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 2768

THREE Months' engagement, Electrical and Mechanical Engineer, 14 years' experience, drawing office and inspecting, London preferred.—2776, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 2776

TRAVELLER.—Electrical Engineer, practical experience, desires appointment as above.—"B.," 130, Albert Road, Croydon. 2731

TRAVELLER, with extensive and first-class connection, requires re-engagement. 13 years' electrical experience. Highest references. Eastern, Midland, Western and Southern counties. Moderate terms.—2349, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 2349

WANTED.—Berth as Salesman in good firm by young man of good address, knowledge of fittings, motors, and accessories. Trained in workshop and office. 12 years' experience. Good reference.—2798, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 2798

WANTED to apprentice Youth aged 16 to the electrical engineering, small premium given, London district.—"A. S.," 57, Gayville Road, New Wandsworth. 2663

WIREMAN (competent) wants job, casing, Simplex.—W. CHARLES, 57, Prebend Street, Islington. 2869

WIREMAN, competent, reliable, good references, wants work.—"ELECTRIC," 31, Temple Street, Brighton. 2867

WIREMAN wants job, quick and reliable. Own casing, Simplex, and conduit. Good references.—"J. O. P.," 101, Elgar Road, Reading. 2876

WIREMAN requires re-engagement; 17 years' experience in house installations and motors.—"D.," 56, Cranbrook Road, Chiswick. 2812

WIREMAN, thoroughly competent, wants job.—BATES, 63, Eastwood Street, Streatham Common. 2834

WIREMAN, young, all-round hand, seeks situation, town or country.—"E.," 145, First Avenue, Manor Park. 2829

WIREMAN, good references, casing, simplex, barrel, &c.—"E," 44, Millbrook Road, Brixton. 2839

WIREMAN and Assistant (good) want job, home or abroad.—"P.," 107, Wellesley Road, Gt. Yarmouth. 2830

WIREMAN-Assistant wants work; two years' experience; good references; age 19.—"D. T.," 28, Bradmore Park Road, Hammersmith. 2858

WIREMAN-Mechanic wants berth; references.—"C. W.," 7, Oak Villas, Sirdar Road, Hornsey. 2815

WIREMAN'S Assistant wants job, 5d., own tools.—WETHERILL, 21, Lisburne Road, Hampstead. 2693

WIREMEN (two) want job, town or country. State wages, &c.—"H.," 104, Beckton Road, Canning Town. 2832

SITUATIONS WANTED.—*Continued.*

YOUNG Electrical Engineer, accustomed to polyphase and direct power and lighting, complete plants, central station practice, &c., is open for engagement, abroad preferably. Up-to-date methods, energetic worker. — 2787, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 2787

YOUNG Electrician wants situation; good knowledge of electro-chemistry, accumulator work and testing. — 2724, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 2724

YOUNG Gentleman, good credentials and experience, desires situation; commercial manager, confidential or other position of trust, London preferred.—2572, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 2572

AGENCIES.

Where Advertisements are to be answered to a given number, letter, or *nom de plume* at the ELECTRICAL REVIEW Office, applications for names and addresses of the Advertisers will be entirely disregarded.

Cheap prepaid Advertisements are inserted under this heading at the rate of One Penny Per Word (minimum 1s.). Three Consecutive Insertions for the price of two.

Box Number and ELECTRICAL REVIEW address count as seven words.

AN Electrical Engineer, Assoc.M.Inst.C.E., wishes to represent firms manufacturing continuous and alternating current machinery, arc lamps, cable, &c., in Manchester and the North.—Address, 2820, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 2820

ELECTRICAL Engineers and Contractors wanted to sell our guaranteed lamps, 7/- dozen low voltage, 9/- dozen high voltage.—Write for samples and liberal trade terms to CONSOL ELECTRIC LAMPS, 17, Victoria Street, London, S.W. 1258

IMPORTANT.—Makers high grade Conduit, wishing to open depôts in Birmingham, Bristol and Ireland, invite applications from responsible and pushing Agents who have warehousing facilities. Must have first-rate trade connection and be well in touch with consulting engineers. Liberal terms.—2678, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 2678

TO Consulting Engineers, &c.—Required immediately representatives for the sale on commission of well-established boiler coverings in London district. Connection amongst steam users essential.—LAWSON'S NON-CONDUCTING COMPOSITION, LTD., Bristol. 2862

PARTNERSHIPS.

Where advertisements are to be answered to a given number, letter, or *nom de plume* at the ELECTRICAL REVIEW Office, applications for names and addresses of the Advertisers will be entirely disregarded.

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Box Number and ELECTRICAL REVIEW address count as seven words.

GENTLEMAN required to take the position of Managing Partner in a large and prosperous manufacturing electrical engineering concern. He must be a capable and thoroughly qualified electrical engineer, and have had experience in manufacturing power plants. One with a knowledge of three-phase work preferred. Must also be prepared to invest capital. Principals only treated with.—Apply, in first instance, giving full particulars, to "ELECTRICIAN," care of Messrs. Fisher & Stephens, Solicitors, 6, New Court, Lincoln's Inn, London, W.C. 2797

PARTNER Wanted in well established trading and manufacturing business. Hard work, technical and business ability of more importance than large capital.—State age, experience, capabilities and available capital, to "Z. G.," 983, Messrs. Deacon's, Leadenhall Street, London. 2662

PARTNER required by Traveller, with private and builders' electrical installation connection.—2753, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 2753

PRACTICAL Engineer, with some capital, wanted to take active part in management of well-established installation and contracting business in large Midland centre.—2827, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 2827

REQUIRED for an old-established prosperous electrical business, a young and active engineer as Junior Partner, with capital. Must be an experienced engineer and accustomed to the sale and handling of electricity meters, motors, dynamos, and arc lamps. Principals only treated with.—Apply, in the first instance, giving full and *bona fide* particulars, to 2446, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 2446

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FOR SALE.

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Box Number and ELECTRICAL REVIEW address count as seven words.

ACCESSORIES, Switches, Ceiling-roses, Lampholders, Wall-plugs, &c., best makes, suitable for 100 volts, large quantities. Cheap.—GEE, 52, Upper Jackson Street, Manchester. 2592

ALTERNATING Dynamo and Exciting Dynamos, Transformers, Switchboard and Instruments, cheap.—Apply, 126, Shacklewell Lane, Dalston, London. 2774

BATTERY for Sale.—Battery of 110 27-plate cells in first-class condition.—Apply JONES BROS., Oakwood Court, Addison Road, W. 2398

CROSSLEY Gas Engine 14 nominal, Holmes Dynamo 125 volts 150 amps., two sets of accumulators, elaborate switchboard, cheap.—GEORGE PIGGOTT & Co., 110, Cannon Street, London. 2550

ELECTRIC Generating Plant for Sale in first-rate condition. Capacity of plant 35 KW. and 90 KW., 105 volts direct-coupled to Belliss engines. Also Boilers, Switchboard, &c. Low price for cash.—Apply "Plant," c/o Walker's Advertising Agency, 79, Cornhill, E.C. 2719

ELECTRIC Installation.—Ready for delivery, consisting of Mather & Platt multipolar dynamo, 250 volts and 1400 amperes at 105 revs., and Galloway vertical compound Corliss engine, 600 to 700 I.H.P., cylinders 18 in. and 34 in., stroke 36 in. Suitable for 150 lbs. pressure. Low price for immediate sale.—For further particulars apply GALLOWAYS LIMITED, Manchester. 1994

ELECTRIC Lighting Plant for Sale, consisting of Dynamo, Switchboard, Cables, Cells, and Crossley Gas Engine. Can be seen working.—Apply WILLIAM WILLIAMSON, Architect, Kirkcaldy, N.B. 2792

FOR Sale.—Three 50-N.H.P. loco.-type Boilers by Robey, insurance tested, and will insure each for 150 lbs. steam.—A. UNDERWOOD, 3, Queen Street, London, E.C. 2764

FOR Sale or Hire, 18 dynamos and motors, various sizes and voltages.—MARTIN, Electrical Engineer, Kidderminster. 2808

FOR Sale.—One combined Petrol Engine and Dynamo, 110 volts 20 amps., 1500 revs.—Apply Box 26, General Post Office, Leicester. 2637

FOR Sale or Hire, high-class dynamos, motors, alternators, cable and arc lamps.—PERCY HUDDLESTON & Co., 72, Finsbury Pavement, E.C. 1592

FOR Sale, three motors, 15 H.P., 7 H.P., 1½ H.P., 105 volts, first-class makers; any reasonable offer accepted.—Apply by letter to "D. M.," c/o Abbott's, 32, Eastcheap, London, E.C. 2564

FOUR Dynamos, bi-polar undertype, 3 bearings, 110, 140, and 220 volts, 30 KW. capacity at 850 r.p.m., absolutely as new; guaranteed 12 months. Price £65 each.—ELECTRICAL ENGINEERING STORES, 11, Upper Priory, Birmingham. 2854

MODERN Electrical Engineering Works for Sale as a going concern, equipped with up-to-date machinery for economical production, land area 4105 sq. yards on 990 years' lease, subject to small chief, with room for extension, situate in Salford, Manchester. Moderate purchase price.—For full particulars apply Messrs. DAVID SMITH, GARNETT & Co., Chartered Accountants, 22, Booth Street, Manchester, or to WHEATLEY KIRK, PRICE & Co., Albert Square, Manchester. 2784

MOTOR, shunt, 33 H.P., 110 volts, good make, £55.—MARTIN, Electrical Engineer, Kidderminster. 2807

NEVILLE Accumulator Switch, perfect, £2; Voltmeters, 160; Bridge, by Elliott; Motors, Cable, Switches, cheap.—Particulars, WALTON, Electrician, Gloucester. 2837

SWITCHBOARD.—Ammeter, reading 60 amperes, Voltmeter, 160 volts, charge and discharge switch for cells, automatic cut-out and change-over switches, &c., mounted on slate slab in solid oak frame. Particulars on application.—LAVERICK & Co., Carliol Square, Newcastle. 2779

TWO 45-brake H.P. Stockport Gas Engines and two 300-amperes 110-volt continuous-current shunt-wound Crompton Dynamos, including automatic switches and shunt resistances; all in good working condition; removed to instal larger machinery.—Apply to Mr. BAKER, Clerk of Works, Royal Agricultural Hall, Islington. 2775

VICTORIA Screw Making Machine, 4½" centre, by Selig, Sonnenthal & Co., tools and countershaft.—OWEN, Ford's Works, Cannon Street, Hanley. 2680

20 Coils (110 yds. each) twin office wire. What offers? Samples.—GRAY, 9A, Albion Mews East, Albion Street, W. 2875

80-KW. 460 volts, direct coupled Steam Dynamo, 120 lbs., 350 revolutions, practically new, immediate sale.—Price and particulars of GEORGE PIGGOTT & Co., 110, Cannon Street, London. 2649

FOR SALE.—*Continued.*

2000-VOLT Alternator and Transformer, by Crompton, nearly new condition, £80.—THOMAS PARKES, 285, Broad Street, Birmingham. 2773

BUSINESSES FOR SALE.

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Cheap Prepaid Advertisements are inserted under this heading at the rate of One Penny per Word (minimum 1s.). Three Consecutive Insertions for the price of two.
Box Number and ELECTRICAL REVIEW address count as seven words.

SCIENTIFIC and Electrical Instrument Manufacturer's Business, with good lighting connection, for disposal, London, E.C.; would suit an energetic young man. Capital necessary about £300. Good reasons given for selling.—2868, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 2868

TO be sold, an old established Electrical Business with a good connection. Satisfactory reasons given for disposal.—For particulars, "K 644," Birchall's Advertising Offices, Liverpool. 2565

ARTICLES WANTED.

Where Advertisements are to be answered to a given number, letter, or *nom de plume* at the ELECTRICAL REVIEW Office, applications for names and addresses of the Advertisers will be entirely disregarded
Cheap prepaid Advertisements are inserted under this heading at the rate of One Penny Per Word (minimum 1s.). Three Consecutive Insertions for the price of two.
Box Number and ELECTRICAL REVIEW address count as seven words.

ACCUMULATORS, Second-hand, any type, wanted; also lead peroxide, old copper cable, scrap metals, and every description of metallic dross purchased for cash, town or country.—Write, A. BROWN & SONS, 77, Lansdowne Road, Dalston, N.E. Telephone: 326, Dalston. 8534

FIRMS having direct coupled traction units (500 KW. or over) ready for immediate disposal are invited to communicate with 2846, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 2846

PLATINUM, in any form and quantity, purchased at highest prices by DERBY & Co., 44, Clerkenwell Road, London. 6522

WANTED, good second-hand oil engine, about 6 or 8 B.H.P., for driving dynamo.—"W. B.," 21, Hill Road, Wimbledon. 2778

WANTED, second-hand Shunt-wound Dynamos, 500 volts, 40 K.W. or larger. Good condition. Particulars and price to "ELECTRICIAN," Beverley Hotel, Cullercoats, Newcastle-on-Tyne. 2771

WANTED.—Shunt-wound Dynamo, 135 volts, 70 amperes; also one, 135 volts, 20 amperes; quantity of Cable, various sizes; Continuous Current Meters, &c.—Offers to PAYER, 26, Rendezvous Street, Folkestone. 2698

WANTED.—Electric Lamp Tops and Scrap Platinum.—EDEY AND Co., 29, Ludgate Hill, London. 2292

MISCELLANEOUS.

Where Advertisements are to be answered to a given number, letter, or *nom de plume* at the ELECTRICAL REVIEW Office, applications for names and addresses of the Advertisers will be entirely disregarded.
Cheap prepaid Advertisements are inserted under this heading at the rate of One Penny Per Word (minimum 1s.). Three Consecutive Insertions for the price of two.
Box Number and ELECTRICAL REVIEW address count as seven words.

ACCUMULATOR CHARGING.—C. H. Cathcart & Co., having plant specially adapted for this purpose, charge cells of all sizes promptly, thoroughly and cheaply. Terms on application. Accumulators on hire for temporary lighting, experimental uses, &c.—3, Dorset Buildings, Salisbury Square, Fleet Street, E.C. (Telephone No. 266, Holborn). 7365

EPSTEIN Accumulator Plates for Storage Batteries are now supplied by the sole licensees and makers, W. O. ROOPER AND Co., Electrical Engineers, Stafford. 80

A. C. COSSOR, A.M.I.E.E. (Government contractor), with qualified assistants, good machinery, gas and electric power, alternating and continuous current, would undertake any experimental work, or contract for the trade. Special facilities available for inventors.—54, Farringdon Road, E.C. 2272

FOR independent testing apply to WESTMINSTER ELECTRICAL TESTING LABORATORY, York Mansion, York Street, Westminster. Write for scale of fees. 2242

GLASS Blower.—H. HELM, 66, Hatton Garden, London, E.C., Maker of X-ray tubes, glass instruments, mercury pumps and vacuum tubes. 2590

(Continued on next page.)

MISCELLANEOUS.—*Continued.*

HIGH-CLASS Electric Fittings for hire. Specially adapted for easy fixing in temporary work. Particulars on application.—SIMMONDS BROS., LTD., 4, 6 & 8, Newton Street, Holborn, W.C. 2649

LIGHTING Contractors.—Splendid opening for lighting, power and motor car repairing.—Apply 2623, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 2623

MOTOR Repairs by experts; armature winding, &c. Accuracy guaranteed.—MILLWOOD Co., 105, Clapham Park Road, S.W. 2872

SEARCHLIGHTS for sale or hire.—JOHNSON & PHILLIPS, Victoria Works, Charlton, Kent. 3945

WANTED, the Addresses of large buyers of mica for all purposes; also Addresses of manufacturers of micanite using ground mica, by seller of Canadian mica.—Address, Box 3619, Sell's Advertising Offices, London, E.C. 2551

WRITE FOR OUR NEW CATALOGUE.

150 PAGES OF ILLUSTRATIONS.

CONVEYING PLANT.

MAKERS:

Graham, Morton & Co. Ltd.

Works:—

LEEDS, ENG.

National Life Buildings, Martin Place, Sydney, N.S.W.

LENNOX HOUSE, NORFOLK ST. STRAND, W.C.

EVERSHED & VIGNOLES, Ltd.,

MAKERS OF ALL KINDS OF

ELECTRICAL INSTRUMENTS.

See Advertisement June 5. 3776

Educational Notice.

ENGINEERING AND CHEMISTRY.

City and Guilds of London Institute.

SESSION 1903-1904.

THE Courses of Instruction at the Institute's **Central Technical College,** (Exhibition Road), are for Students not under 16 years of age; those at the Institute's **Technical College, Finsbury,** for Students not under 14 years of age. The Entrance Examinations to both Colleges are held in September, and the Sessions commence in October. Particulars of the Entrance Examinations, Scholarships, Fees, and Courses of Study, may be obtained from the respective Colleges, or from the Head Office of the Institute, Gresham College, Basinghall Street, E.C.

CITY AND GUILDS CENTRAL TECHNICAL COLLEGE

(EXHIBITION ROAD, S.W.)

A College for higher Technical instruction for Day Students, not under 16, preparing to become Civil, Mechanical, or Electrical Engineers, Chemical and other Manufacturers, and Teachers. The College is a School of the University of London in the Faculty of Engineering. Fee for a Full Associate Course, £30 per Session. Professors:—

Civil and Mechanical Engineering	W. C. Unwin, F.R.S., M.Inst.C.E. (Dean)
Electrical Engineering	W. E. Ayrton, F.R.S., Past Pres.Inst.E.E.
Chemistry	H. E. Armstrong, Ph.D., LL.D., F.R.S.
Mechanics and Mathematics ..	C. Hearlet, Ph.D., LL.D., F.R.S.

CITY AND GUILDS TECHNICAL COLLEGE, FINSBURY.

(LEONARD STREET, CITY ROAD, E.C.)

A College for Day Students, not under 14, preparing to enter Engineering and Chemical Industries, and for Evening Students. Fees, £15 per Session for Day Students. Professors:—

Physics and Electrical Engineering	S. P. Thompson, D.Sc., F.R.S., Principal of the College.
Mechanical Engineering and Mathematics ..	W. E. Dalby, M.A., B.Sc., M.I.C.E.
Chemistry	R. Meldola, F.R.S., F.I.C.

City and Guilds of London Institute,
Gresham College, Basinghall Street, E.C. 2783

Filed with the Registrar of Joint Stock Companies in Scotland.

The Subscription List will Open on Saturday, 27th June, and Close on or before Tuesday, 30th June, 1903.

BRUCE PEEBLES & Co., Ld.

ENGINEERS, TAY WORKS, EDINBURGH

(Incorporated under the Companies Acts, 1862 to 1900).

Capital - - - £200,000,

Divided into 20,000 Six per cent. Cumulative Preference Shares of £5 each £100,000

(For each year in respect of which more than 6 per cent. is paid on the Ordinary Shares the Preference Shares will receive the same rate of Dividend as the Ordinary Shares with a maximum of Seven-and-a-half per cent.)

20,000 Ordinary Shares of £5 each 100,000

£200,000

Issue of 20,000 Preference Shares and 3,000 Ordinary Shares at par:—Payable £1 per share on application, £2 per share on allotment, and £2 on 21st August, 1903.—Total, £5 per share.

Directors.

WILLIAM CARMICHAEL PEEBLES, Hope Lodge, Trinity, Edinburgh, Engineer.
ARTHUR CHARLESWORTH PEEBLES, Hope Lodge, Trinity, Edinburgh, Engineer.
ROLAND SYDNEY PORTHEIM, 39, Victoria Street, London, S.W., Engineer.
MONTAGUE TADOR PICKSTONE, Tay Works, Edinburgh, Engineer.
(Joint Managing Directors.)
HENRY MUNGALL, Coalmaster, 20, Royal Terrace, Edinburgh.

Bankers.

ROYAL BANK OF SCOTLAND, Edinburgh, Glasgow, London, and Branches.

Solicitors.

WYLIE & ROBERTSON, W.S., 54, Queen Street, Edinburgh *(For the Vendors.)*
DAVIDSON & SYME, W.S., 28, Charlotte Square, Edinburgh *(For the Company.)*

Auditors.—ROBERTSON & CARPHIN, C.A., Edinburgh and Glasgow.

Brokers.

LAURIE, MILBANK & Co., 31, Threadneedle Street, London, E.C.
H. GILMOUR & SHAW, 16, St. Andrew Square, Edinburgh.

Secretary *(pro. tem.).*—JOHN REID PEEBLES.

Registered Office.—TAY WORKS, EDINBURGH.

ABRIDGED PROSPECTUS.

THE Company has been formed to acquire as a going concern, and to carry on the old-established business of D. BRUCE PEEBLES & Co., Engineers, Edinburgh, with offices in London, Cardiff, Manchester and Newcastle-on-Tyne, and agencies in other towns. The Managing Directors state that:—

"The reason for converting the business into a Limited Company is:—*Firstly*, to pay to the Trustees of the late Mr. D. BRUCE PEEBLES the sum of £80,000, as under the terms of the will they have only power to retain a limited holding in the business; *secondly*, to provide additional capital for extension.

"The business was established in the year 1866 by the late Mr. D. BRUCE PEEBLES, whose many valuable inventions of gas apparatus soon brought the firm's appliances into wide use both in Gas Works and by Gas Consumers.

"The Electrical Department was added in 1898, and, from the first, has been a success, the sales of each year showing a marked increase on the previous year. The manufactures in this department include Dynamos, Motors, Alternators, Boosters, Switchgear, and every description of Electrical plant for Tramways, Lighting and Electrical transmission of power.

"The orders received during the five months ending 31st May, 1903, exceed those of the corresponding period of any year of the firm's existence.

"An Agreement has been entered into dated 1st April and 12th May, 1903, whereby the firm has for a period of ten years from 30th May, 1902, acquired the sole manufacturing rights for Great Britain, her Colonies and Dependencies, under the electrical patents of Messrs. GANZ & Co., Budapest.

"The firm has acquired, on favourable terms, 10 acres of land with the option of four additional acres adjoining, at East Pilton, on the Caledonian line to Granton, about two miles from Princes Street Station, Edinburgh, where new works are now under completion, and are being fitted with the most modern labour-saving and automatic machinery. These new works cost £53,000 (exclusive of existing plant), the buildings are being rapidly completed and will be finished within three months. Sidings have been laid direct into the works, and every facility is being provided for the rapid handling of goods."

The Auditors, Messrs. Robertson and Carphin, C.A., Edinburgh, have given the following Certificate of Profits for the three years ending 31st December, 1902, which profits were of course earned upon the capital then in the business, and without the aid of the new works:—

AUDITORS' REPORT.

Edinburgh, *February 17th*, 1903.

We have examined the Books and Accounts of Messrs. D. BRUCE PEEBLES AND Co., Gas and Electrical Engineers, Tay Works, Bonnington, Edinburgh, for the three years ending 31st December, 1902, and we certify that the Profits have been as follows:—

For the year ending 31st December, 1900..	£9,719	16	0
" " " 1901..	13,917	17	2
" " " 1902..	13,486	7	9

These results have been arrived at after providing for all working expenses, including Partners' and Managers' Salaries, Repairs, Renewals of Tools and Machinery, and Depreciation at the rate of 5 per cent. per annum on the book value of the working plant, but without deducting interest on Capital and Loans, or Income Tax paid on Profits.

(Signed) ROBERTSON & CARPHIN, C.A.

The Company will take over the business as at December 31st, 1902, and will be entitled to the Profit made since that date, under deduction of Interest at 5 per cent. per annum on the purchase price from 31st December, 1902, till date of payment or allotment of the shares as the case may be. The Company will collect the debts due to the business then outstanding and account to the firm therefor; on the other hand, the firm will pay the debts of the business due at that date.

The sum so withdrawn in cash is, as already mentioned, to be paid to the Trustees of the late Mr. Bruce Peebles, the remainder of the proceeds of the issue being retained by the Company.

The property to be acquired by the Company consists of the following:—

Machinery, Movable Plant Patterns, including Gas and Electric Services, Stock, Stores, Work in Progress and finished stock, valued at	£61,964	8	6
Sundry investments, &c., entered in the Balance-Sheet at ..	306	9	9
Cash for Working capital	25,017	19	5
	£87,288	12	8
Trade Marks, Patents and Trade Names of the Firm, the Goodwill of the business, and the Vendors' interest in all contracts in connection therewith	27,711	7	4
	£115,000	0	0

The purchase-price has been fixed at £115,000, payable £85,000 in Ordinary Shares and £30,000 in cash.

In addition to the assets shown above	£87,288	12	8
The net proceeds of the present issue will be applied:—			
1. In payment of new buildings, machinery, tools, &c. ..	53,000	0	0
2. For additional Working Capital	22,000	0	0
Making the Total Assets (exclusive of Trade Marks, Patent and Goodwill)	£162,288	12	8

Taking into consideration that double the capital hitherto employed will be available, and that the manufacture will be conducted under more economical conditions in the new works than was possible heretofore, the directors are of

opinion that the profits will be doubled, or say £26,000 per annum, but an increase of less than £5,000 only per annum (after allowing for Reserve) would provide for the Preference Shares receiving their max mum dividend of 7½ per cent.

By the Memorandum of Association it is provided:—

(1) That the Preference Shares be entitled to a cumulative preferential dividend at the rate of 6 per cent. per annum.

(2) That at least 10 per cent. of the annual net profits (before paying the said preferential dividend) shall be put to a Reserve Fund to be invested outside the business until such fund amounts to £25,000, at which figure it is to be maintained.

(3) That in any year in respect of which a dividend in excess of 6 per cent. shall be paid on the Ordinary Shares, the Preference Shares shall be paid such a dividend as will (including the fixed dividend) raise their dividend for that year to the same dividend as that paid on the Ordinary Shares, but not exceeding 7½ per cent.

(4) That in a winding-up the Preference Share capital be paid off in priority to the Ordinary Share capital, and after the Ordinary Shares have been paid off the Preference Shares shall participate in the distribution of any surplus assets equally with the Ordinary Shares, but so that not more than a sum equal to 25 per cent. on the capital paid up on each Preference Share shall be paid.

The Borrowing Powers are limited to £50,000, but may be increased by special resolution of the Preference Shareholders.

The qualification of each Director is the holding of £1,000 of the capital of the company, and the Directors' remuneration has been fixed at £150 per annum each with £50 per annum additional to the Chairman. The managing Directors will receive by way of an additional remuneration £500 per annum a-piece; there will also be paid to each managing director a bonus of £125 for every 1 per cent. dividend paid on the Ordinary Shares in excess of 8 per cent. per annum, such bonus not to exceed to each Director £500 as a maximum. The remuneration of the directors will run as from 1st January, 1903, the arrangement with the managing directors being for seven years from that date.

The Company will not go to allotment unless the issue is fully subscribed.

Stock Exchange quotations for the Preference Shares will be applied for in London and Edinburgh.

The total expenses of the formation and registration of the Company and of this issue (inclusive of the sum of £8,400 to be paid to the London Trust Co., Ltd., under the agreement above referred to) is estimated at £10,000.

Applications should be made on the form accompanying the Prospectus, and be sent to the Bankers, with the deposit on application. If no allotment is made, the deposit will be returned in full, and where the amount allotted is less than the amount applied for, the balance will be applied towards payment of the amount due on allotment.

Copies of the full Prospectus and Forms of Application may be obtained from the Bankers, Brokers, and at the Offices of the London Trust Co., Ltd., 37, Lombard Street, London, E.C.—*25th June*, 1903.

INSTRUMENTS AND PLANT TESTED.

THE ELECTRICAL STANDARDIZING, TESTING AND TRAINING INSTITUTION.

(Proprietors: The Syndicate of Electrical Engineers, Ltd.),

ESTABLISHED 1889,

FARADAY HOUSE,

8 & 10, CHARING CROSS ROAD, LONDON, W.C.

Telephone No. 1048, *Gerrard.* *Telegraphic Address:* "*Standardizing, London.*"

Standardizes and Tests Electrical Instruments.
Inspects and Certifies every kind of Electrical Plant and Materials.
Investigates and Reports upon Electrical Inventions.
Inspects Installations of Electric Wires and Plant on behalf of Architects, Householders, Manufacturers, Supply Companies, Fire Offices, &c.
Lets Private Experimenting Rooms, and offers every facility, with skilled assistance when desired, to Experimenters in Electrical Science.

A Scale of Fees will be sent on application to the Secretary.

"ELECTRICAL REVIEW."

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Lahmeyer Motors.

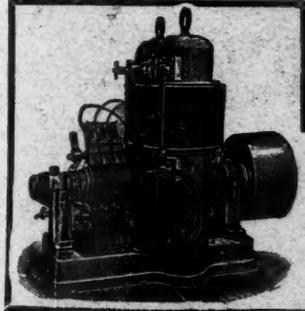
LAHMEYER ELECTRICAL CO., Ltd., 109-111, New Oxford St., W.C.

See Advertisement in last issue, page 37.

THE STIRLING BOILER CO., Ltd.,

2, ST. ANDREW SQUARE, EDINBURGH.

See Illustrated Advertisement, last week.



"CASTLE"

SLOW SPEED.

HIGH EFFICIENCY.

J. H. HOLMES & CO.

NEWCASTLE-ON-TYNE,

AND

17, SOHO SQUARE, LONDON, W.

DYNAMO

HOLDEN-D'ARSONVAL

GALVANOMETERS.

SENSITIVE. PORTABLE. DEAD-BEAT.

PATTERN A - £6 10 0 | PATTERN B - £4 0 0

IMAGE ON SCREEN.

LANTERN D'ARSONVAL GALVANOMETER

£5 AS USED AT UNIVERSITY COLLEGE, &c.

HOLDEN (PATENT)

EXCESS CURRENT ALARM

RINGS BELL WHEN CURRENT REACHES LIMIT.

£2

JAMES PITKIN & CO., 56, Red Lion Street, Clerkenwell, E.C.

CONNOLLY BROS., Ltd.,

BLACKLEY, Manchester,

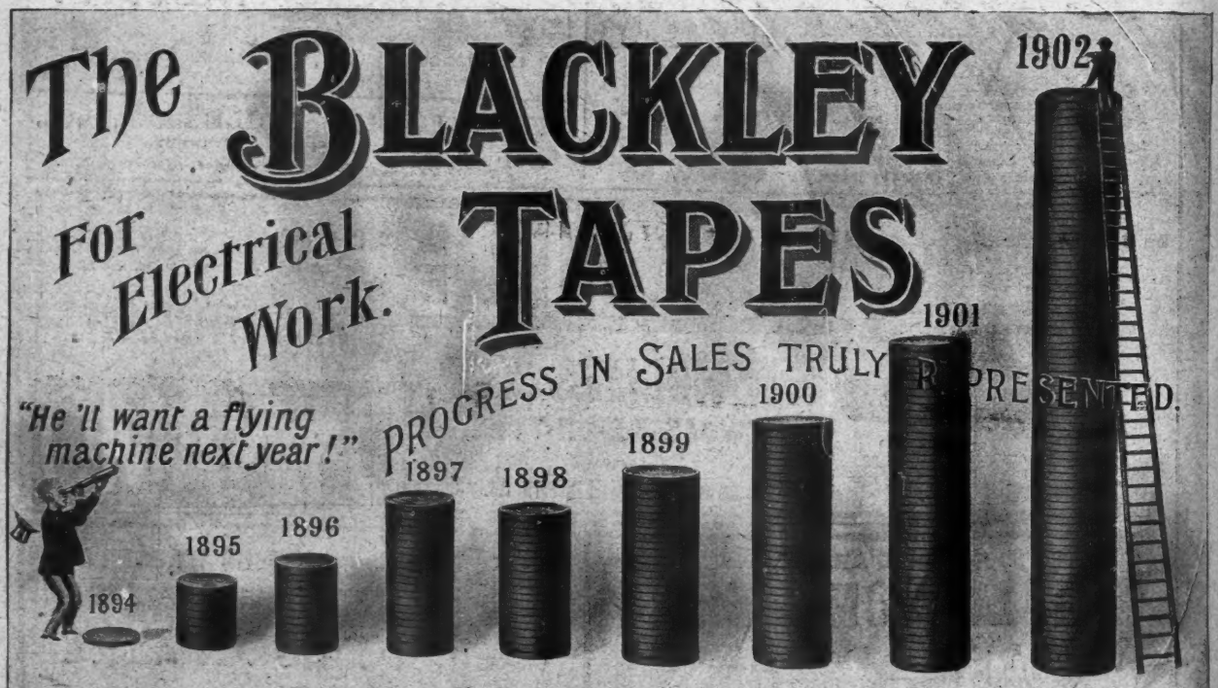
Insulated Wire and Cable Manufacturers.

Telephone No. 2361. **Telegrams:—"CONNOLLYS, BLACKLEY."**

SOLE MANUFACTURERS OF

BLACKLEY TAPE.

The BLACKLEY TAPES For Electrical Work.



WRITE FOR ILLUSTRATED PAMPHLET DESCRIBING OUR NEW SPECIALITY,

BIAS CUT TAPE.

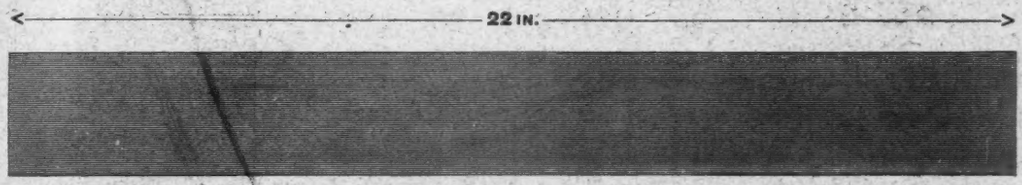
Special Fine Tapes for Dynamo and Motor Manufacturers.

Insulating Tapes are usually bought by weight, but are used by length.

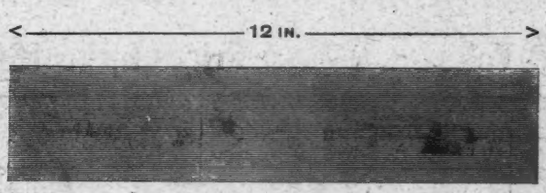
This is the size of a roll of "Blackley" Tape.

This is the size of a roll of ALLEGED cheap Tape of exactly the SAME WEIGHT as the roll of "Blackley" Tape opposite.

These illustrations show what we mean.



This is the length of a given weight of "Blackley" Tape.



This is the length of the SAME WEIGHT of an ALLEGED cheap Tape.

Do not waste your money in buying so-called CHEAP Tapes. Insist on having BLACKLEY Tape, which is the recognised standard of quality. It is the Best. It is the Cheapest.

SOLE MANUFACTURERS:

CONNOLLY BROS., LTD.,

BLACKLEY, MANCHESTER.

NALDER BROS. & THOMPSON'S

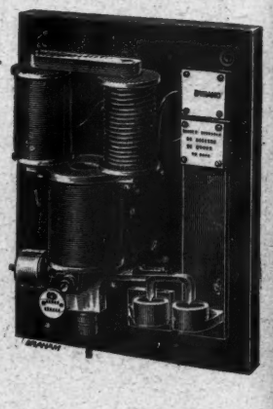
N.C.S.

AUTOMATIC

ACCUMULATOR SWITCH

(CRAWLEY'S PATENT).

THIS INSTRUMENT DOES NOT INFRINGE ANY PATENTS.



This Switch is entirely electro-magnetic, it does not require to be set for any particular voltage as it is purely differential in its action, and having no permanent magnet, it is impossible for it to become reversed.

It automatically closes the circuit when the charging E.M.F. is about 6 volts above that of the cells. If for any reason dynamo voltage falls, it opens the circuit at practically zero current, and thus sparking at the contacts is avoided.

Mounted on enamelled slate 12 in. by 9 in. with back connections.

Prices up to 80 Volts.

Max. current amperes.	Code word.	£ s. d.
50	Sabadilla	5 5 0
100	Sabbath	5 15 0
150	Sabianism	6 5 0
200	Saccade	6 15 0
300	Sacer	7 10 0
400	Sachem	8 5 0
500	Sackbarrow ...	9 0 0

Prices up to 160 Volts.

Max. current amperes.	Code word.	£ s. d.
50	Sacking	5 15 0
100	Sacrarium	6 5 0
150	Sacrificial	6 15 0
200	Sacrum	7 5 0
300	Sad	8 0 0
400	Saddle	8 15 0
500	Saddleroof ...	9 10 0

For Higher Voltages, Prices on Application.

Telegrams :—"OCCLUDE, LONDON." Telephone Nos. 124 Bank, 6124 Bank.

NALDER BROS. & THOMPSON.

LIMITED.

34, Queen Street, Cheapside, London, E.C.

CATALOGUES FREE ON APPLICATION.

AGENTS BY WHOM STOCK IS KEPT:

Messrs. BERRY, SKINNER & Co., 65, King Street, Manchester.
WM. McGEOCH & Co., Ltd., Morrison's Court, 108, Argyle Street, Glasgow.
ELECTRICAL ENGINEERING STORES, 11, Upper Priory, Birmingham.
ROBERT BOWRAN & Co., 3, St. Nicholas Buildings, Newcastle-on-Tyne.
LUCIEN ESPIR, 11 bis. Rue de Maubeuge, Paris.
OSWALD HAES, 56, Margaret Street, Sydney.
BALMER LAWRIE & Co., Calcutta.

WALTHAM & Co
CIRCUITS IN METALS
36 YORK ST. BUCKINGHAM GATE LONDON S.W.
ARTISTIC SWITCHES
SEE CATALOGUE ALSO PUSHES

HOLDEN & BROOKE, LTD., see Sup. XXVI.

Official Notices.

COUNTY BOROUGH OF WEST HAM.

TO ELECTRICAL ENGINEERS AND OTHERS.

THE COUNCIL hereby invite Tenders for the supply of High-Tension Paper-Insulated Cable for Tramway Feeders, and of Multi-Core Telephone and Pilot Cables.

Specification, Form of Tender, and further particulars may be obtained from the Borough Electrical Engineer, JAMES K. BOCK, Abbey Mills, West Ham, on and after Monday, the 22nd inst., on the deposit of £1, which will be returned on receipt of a *bona fide* Tender.

Tenders, endorsed "Tender for Tramway Cables," to be sent to my office not later than 4 o'clock, on TUESDAY, JULY 14th, 1903.

The Council does not bind itself to accept the lowest or any Tender.

The Contractor will be required to enter into a bond with two sureties for the due performance of the Contract, and no work will be ordered under the Contract until such bond has been duly executed.

The Contractor whose Tender is accepted, and with whom a Contract is entered into, will be required to pay all workmen employed by him in or about the Contract such rates of pay, and observe such hours of labour as are embodied in the schedule, which will be part of the Contract. In the event of any breach of such agreement the Council will enforce the penalty clause in its entirety.

A Tender will not be accepted unless it is stated by the Contractor in the Tender, and proved to the satisfaction of the Council, that the Contractor, at the date of the Tender, pays to the whole of his workmen such rates of wages, and observes such hours of labour as are recognised by the Workmen's Trade Unions in the several localities where his work is done. If, after the Contract is signed, it shall be proved that the said statements of the Contractor in the Tender are contrary to fact, the Council shall be entitled to rescind the Contract, or at its option to recover from the Contractor as liquidated damages, and not as a penalty, the sum of £50.

By order of the Council,
FRED. E. HILLEARY,
Town Clerk.

Town Hall,
Stratford, E.,
June 19th, 1903. 2750

BOROUGH COUNCIL OF ST. PANCRAS

THE SAINT PANCRAS BOROUGH COUNCIL invite Tenders for supplying about 31 miles of Lead Covered and Armoured Cable.

Copies of Specification, Conditions of Contract, and Form of Tender to be obtained upon application to the Chief Clerk, Electricity Department Offices, 57, Pratt Street, N.W., on payment of a deposit of £2, which will be returnable only on receipt of a *bona fide* Tender and Specification.

Tenders to be sent to the undersigned, endorsed "Tender for Cables," by 12 o'clock noon on TUESDAY, the 14th JULY, 1903.

The Council do not bind themselves to accept the lowest or any Tender.

C. H. F. BARRETT,
Town Clerk.

Town Hall,
Pancras Road, N.W.,
June 22nd, 1903. 2785

ST. PANCRAS BOROUGH COUNCIL.

TO WIRING CONTRACTORS.

Goldington Buildings, Great College Street.

THE BOROUGH COUNCIL OF ST. PANCRAS invite Tenders for the wiring and fitting of the above premises for the electric light.

Plans may be seen at, and Specification, Conditions of Contract, and Form of Tender obtained from, the Public Health Department, Town Hall, Pancras Road, N.W., on payment of a deposit of £1, which will be refunded only on the Specification being returned accompanied by a *bona fide* Tender.

Tenders to be sent to the undersigned, endorsed "Tender for Wiring Goldington Buildings," by 12 o'clock noon on WEDNESDAY, the 8th day of JULY, 1903.

The Council do not bind themselves to accept the lowest or any Tender.

C. H. F. BARRETT,
Town Clerk.

Town Hall,
Pancras Road, N.W.,
June 18th, 1903. 2781

Official Notices.—*Continued.*

BOROUGH COUNCIL OF ST. PANCRAS

THE ST. PANCRAS BOROUGH COUNCIL invite Tenders for supplying an Electric Jenny and Grab to their King's Road Power House, Camden Town, N.W.

Copy of Specification, Conditions of Contract, and Form of Tender, to be obtained upon application to the CHIEF CLERK, Electricity Department Offices, 57, Pratt Street, N.W., on payment of a deposit of £2, which will be returnable only on receipt of *bona fide* Tender and Specification.

Tenders to be sent to the undersigned, endorsed "Tender for Electric Jenny and Grab," by 12 o'clock noon on TUESDAY the 14th JULY, 1903.

The Council do not bind themselves to accept the lowest or any tender.

C. H. F. BARRETT,
Town Clerk.

Town Hall,
Pancras Road, N.W.,
June 24th, 1903. 2847

CITY OF COVENTRY.

ELECTRICITY WORKS EXTENSIONS.

PIPE WORK,
ECONOMISER,
COAL CONVEYING PLANT,
STOKERS,
SUNDRIES.

THE CORPORATION OF COVENTRY are prepared to receive Tenders for the supply and erection of the above.

Copies of the Specification may be obtained from the undersigned on receipt of £5 5s., which sum will be returned on receipt of a *bona fide* Tender.

Tenders will only be considered for a section or sections, and not for part of a section.

The Corporation do not bind themselves to accept the lowest or any Tender.

Tenders to be addressed to the Town Clerk, Hay Lane, Coventry, and must be received by him on or before 10 a.m. JULY 2nd.

JOSEPH A. JECKELL,
Engineer.

Corporation Electricity Works,
Sandy Lane,
Coventry. 2671

BOROUGH OF WEYMOUTH AND MELCOMBE REGIS.

ELECTRIC LIGHTING.

THE CORPORATION OF WEYMOUTH AND MELCOMBE REGIS invite Tenders for the supply, delivery and erection of the following, in connection with the electric lighting of the town:—

Contract No. 1.—Lancashire Boilers.
" No. 2.—Engines and Dynamos.
" No. 3.—Overhead Travelling Crane.
" No. 4.—Switchboard and Battery Boosters.
" No. 5.—Storage Battery.
" No. 6.—Arc Lamps and Arc Lamp Posts.
" No. 7.—Pipework, Feed Pumps, Economiser, Ejector, Condensers, &c.
" No. 8.—Distributing Mains and Feeders.

Copies of Specifications Nos. 1 to 7 inclusive, with Forms of Tender and General Conditions, can be obtained on and after Saturday, June 27th, and copies of Specification No. 8, with the same Conditions and Form of Tender, on and after Wednesday, July 1st, from the undersigned, on payment of £2 2s. for each Specification, which amount will be returned on receipt of a *bona fide* Tender.

The Specifications and Drawings can be seen at (but not obtained from) the offices of the Consulting Engineers, Messrs. KENNEDY AND JENKIN, 17, Victoria Street, Westminster, London, S.W.

Tenders, on the prescribed form, in sealed envelopes, and endorsed on the outside "Electric Lighting Tender for No. —— Contract," must be delivered at my office on or before JULY 19th, 1903.

The Corporation do not bind themselves to accept the lowest or any Tender, and no allowance will be made for any expense incurred in the preparation of any Tender.

RICHARD NICHOLAS HOWARD,
Town Clerk.

Town Clerk's Office,
Municipal Offices,
Weymouth,
June 24th, 1903. 2866

[*Continued on Page* 45.]

BOOSTING

HIGHFIELD (Patented) SYSTEM.

Intending adopters of the Highfield System of Booster Regulation are warned that highly successful and satisfactory results, both as regards efficiency and economy, can only be obtained by machines embodying the principles covered by the Highfield Patents.

Equivalent working must not be expected as it cannot be obtained by the so-called automatic reversible boosters being offered to the public, which only give very modified results in an inefficient and very uneconomical manner.

Patents for the Highfield System of Automatic and Semi-automatic Booster Control have been granted in Great Britain, Germany, United States, and other Principal Countries in the World, and proceedings will be taken against any infringement of the same.

MACHINES ARE INSTALLED OR ON ORDER FOR THE FOLLOWING CENTRAL AND POWER STATIONS, &c.

City & South London Railway (4 Machines)
Bournemouth & Poole Electric Supply Co. (2 Machines)
Garston & District Electric Supply Co. (2 Machines)
Willans & Robinson, Ltd. (2 Machines)
St. Helens Corporation (2 Machines)
Newport (2 machines)
London, Brighton & South Coast Railway
Blackpool & Fleetwood Tram Co.
Maen Offeren Slate Quarry Co.
Pilkington Bros., St. Helens
Camborne Electric Supply Co.
Gateshead Electric Power Distribution Co.
Merthyr Tydfil Electric Traction Co.
Metropolitan District Electric Traction Co.
Buenos Ayres & Great Southern Railway
Barnsley Corporation
Bexley ,,
Birkenhead ,,
Burnley ,,
Heckmondwike ,,
Stafford ,,
West Bromwich ,,
&c., &c., &c.

FOR PARTICULARS AND PRICES APPLY TO—

THE CHLORIDE Electrical Storage Company, Limited,

CLIFTON JUNCTION,
Near MANCHESTER.

London Office:
39, Victoria Street, S.W.

Official Notices.—*Continued from page 43.*

METROPOLITAN BOROUGH OF STEPNEY.

PIPEWORK, WATER-SOFTENING PLANT AND STORAGE TANKS.

THE ELECTRICAL COMMITTEE of the Stepney Borough Council are prepared to receive Tenders for the supply of Feed, Suction and other Pipework, Water-Softening Plant and Storage Tanks.

Specifications may be obtained after June 29th from the undersigned on depositing the sum of five guineas, which will be returned on receipt of a *bona fide* Tender. Further copies may be had on payment of 5s. per copy, which will not be returned. A copy of the Specificaton may be seen at the undermentioned address.

Tenders must be delivered to this office, signed and sealed, and addressed to the Chairman of the Electrical Committee, not later than noon on TUESDAY, JULY 21st.

The Council do not bind themselves to accept the lowest or any Tender.

ARTHUR WRIGHT,
Consulting Engineer.

27, Osborn Street,
Whitechapel,
June 23rd, 1903. 2825

CITY OF NORWICH.

ELECTRICITY DEPARTMENT.

THE MAYOR, ALDERMEN and CITIZENS OF NORWICH are prepared to receive Tenders for the following :—

1. Rubber-Covered Wires and Cables.
2. Accessories.
3. Continuous Current Meters.
4. Centrifugal Pump and Motor.

Copies of Specification, and Form of Tender may be obtained on application to the City Electrical Engineer, Corporation Electricity Works, Norwich.

Tenders enclosed in envelopes endorsed "Tender for —," and addressed to the Chairman of the Electricity Committee, must be delivered at the Electricity Works, Duke Street, Norwich, not later than 10 a.m., WEDNESDAY, 8th JULY, 1903.

The Corporation does not bind itself to accept the lowest or any Tender.

ARNOLD H. MILLER,
Town Clerk.

Guildhall, Norwich,
23rd June, 1903. 2836

METROPOLITAN BOROUGH OF POPLAR.

THE ELECTRICITY COMMITTEE of the Council of th Metropolitan Borough of Poplar hereby invite Tenders fo the supply of Arc Lamp Carbons.

Specification, General Conditions of Contract, and Form of Tender may be obtained at the offices of the Borough Electrical Engineer, Electricity Works, Glaucus Street, Bromley-by-Bow, E., upon payment of One Guinea in cash, which will only be refunded upon receipt of a *bona fide* Tender.

Sealed Tenders, endorsed upon the outside "Tenders for Carbons," must reach the undersigned by 10 a.m. on the 8th JULY, 1903.

Contractors will be required to pay trade union rates of wages, and observe trade union hours of labour, and must covenant not to sublet any portion af the contract without permission.

Compliance with these conditions will be rigidly enforced under a penalty for each breach.

The Committee do not bind themselves to recommend the acceptance of the lowest or any Tender.

LEONARD POTTS,
Town Clerk.

Council Offices,
High Street, Poplar,
June 25th, 1903. 2848

Official Notices.—*Continued.*

BOROUGH OF DEWSBURY.

ELECTRIC LIGHT AND POWER SUPPLY.

THE ELECTRICITY COMMITTEE of the Borough of Dewsbury invite Tenders for the supply, delivery, and erection of

One Lancashire Boiler.

Copies of the Specification, with Form of Tender and General Conditions, can be obtained from Mr. R. H. CAMPION, Borough Electrical Engineer, Bradford Road, Dewsbury, on deposit of £1, which sum will be returned on receipt of a *bona fide* tender. Tenders, on the prescribed form, in sealed envelopes, and addressed to the Chairman, Electricity Committee, Town Hall, Dewsbury, must be delivered on or before midday, JULY 1st. The Council do not bind themselves to accept the lowest or any Tender.

H. ELLIS,
Town Clerk.

Town Hall,
Dewsbury. 2690

METROPOLITAN BOROUGH OF HAMMERSMITH.

ELECTRICITY DEPARTMENT.

Alternating Current Arc Lamps.

TENDERS are required for the supply of 40 Alternating Current Series Arc Lamps and accessories.

Specification and Form of Tender, &c., can be obtained from the Engineer, Mr. G. G. BELL, Electricity Works, 57, Fulham Palace Road, W., upon payment of £1 1s., which will be returned upon receipt of a *bona fide* Tender. Sealed Tenders to be delivered to me at the Town Hall not later than 6 p.m., WEDNESDAY, JULY 15th.

The Council do not bind themselves to accept the lowest or any Tender.

H. THOMPSON,
Town Clerk

June 23rd, 1903. 2383

BOROUGH OF IPSWICH.

ELECTRIC LIGHT AND POWER SUPPLY.

THE CORPORATION invite Tenders for the supply and delivery of Electricity Meters to Specification No. 14.

Copies of the Specification, with General Conditions of Contract, can be obtained at the office of the undersigned on payment of £3 3s., which will be returned on receipt by the Corporation of a *bona fide* Tender, accompanied by the Specification and General Conditions.

The Specification can be seen at, but not obtained from, the offices of Messrs. KENNEDY & JENKIN, 17, Victoria Street, Westminster, London, S.W.

The Corporation do not bind themselves to accept the lowest or any Tender, and no allowance will be made for the cost of tendering.

Tenders on the prescribed form, enclosed in a sealed envelope, and endorsed "Electric Light and Power Electricity Meters," must reach the undersigned on or before noon on the 14th day of JULY, 1903.

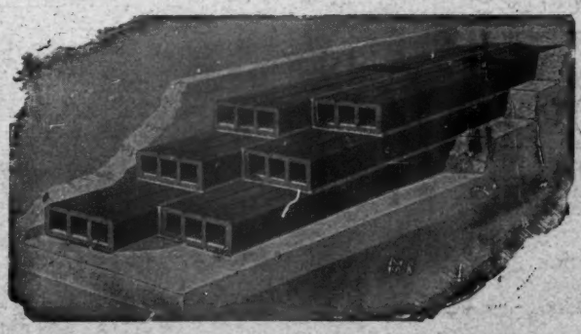
WILL BANTOFT,
Town Clerk.

Town Hall,
Ipswich,
June 25th, 1903. 2856

BELLISS & MORCOM Ltd.
BIRMINGHAM.
PATENT SELF LUBRICATING ENGINES
FOR ELECTRIC LIGHT, POWER OR TRACTION.
See Illustrated Advertisement Alternate Weeks.

Doulton Conduits

For TRACTION
• • •
Minimum Space
Sound Construction
• • •
Doulton & Co. Limited



For LIGHTING
• • •
Minimum Labour
Depreciation Nil
• • •
Lambeth
LONDON S.E.

Best, Most Reliable

ENCLOSED,
FIREPROOF,
WEATHERPROOF,
SUBSTANTIAL.

Cover Removed.

CARBON BREAK,
QUADRUPLE BREAK,
MAGNETIC BLOW-OUTS
ON EACH POLE

D.P. SWITCHES.

20 amps., £2; 50 amps., £3; 200 amps., £5.

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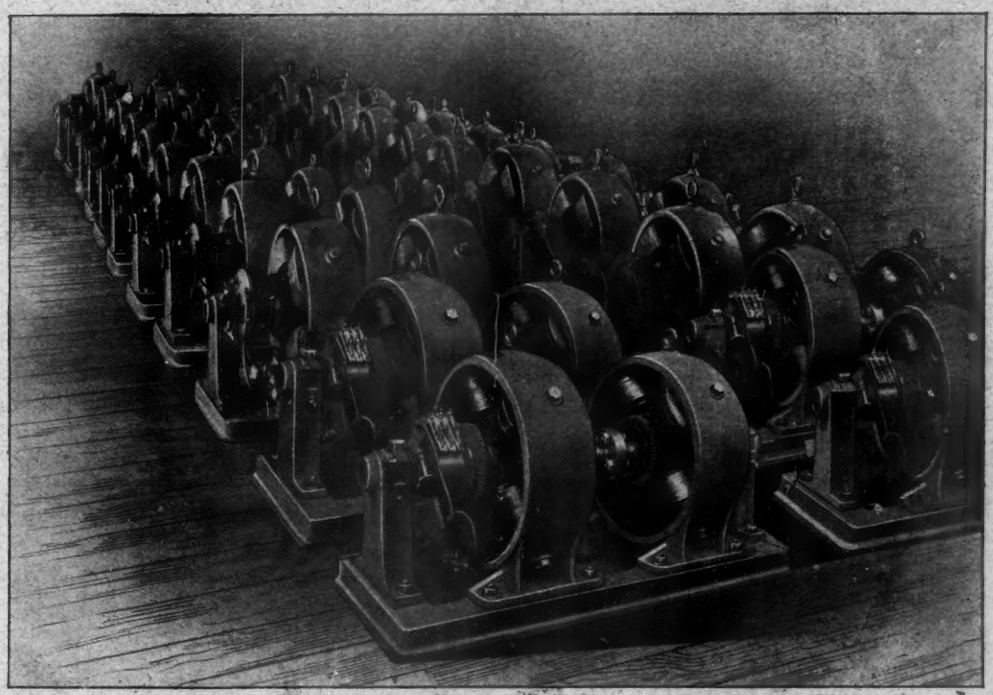

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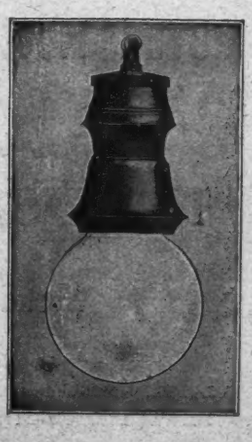

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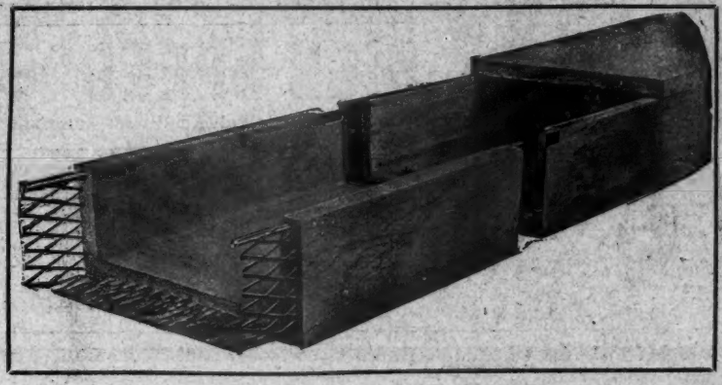

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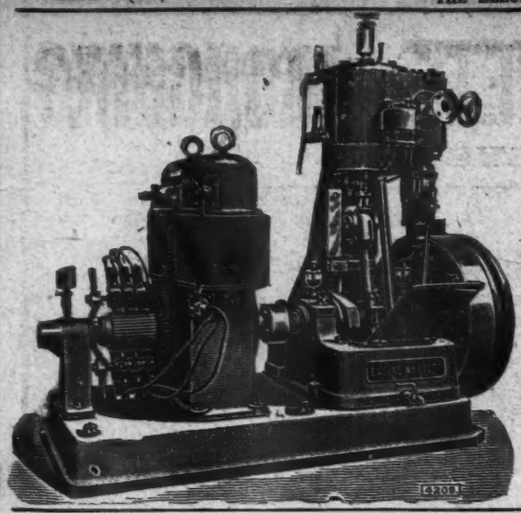

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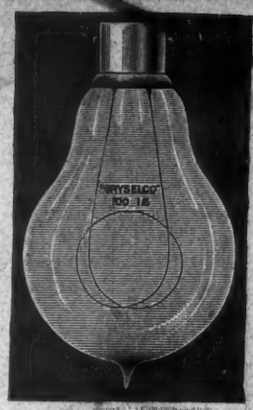

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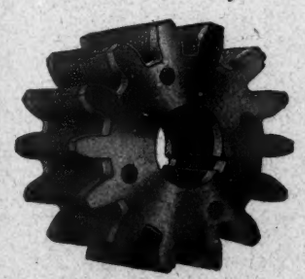

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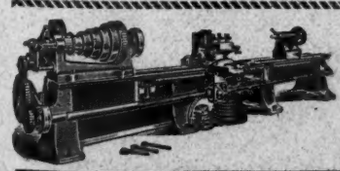

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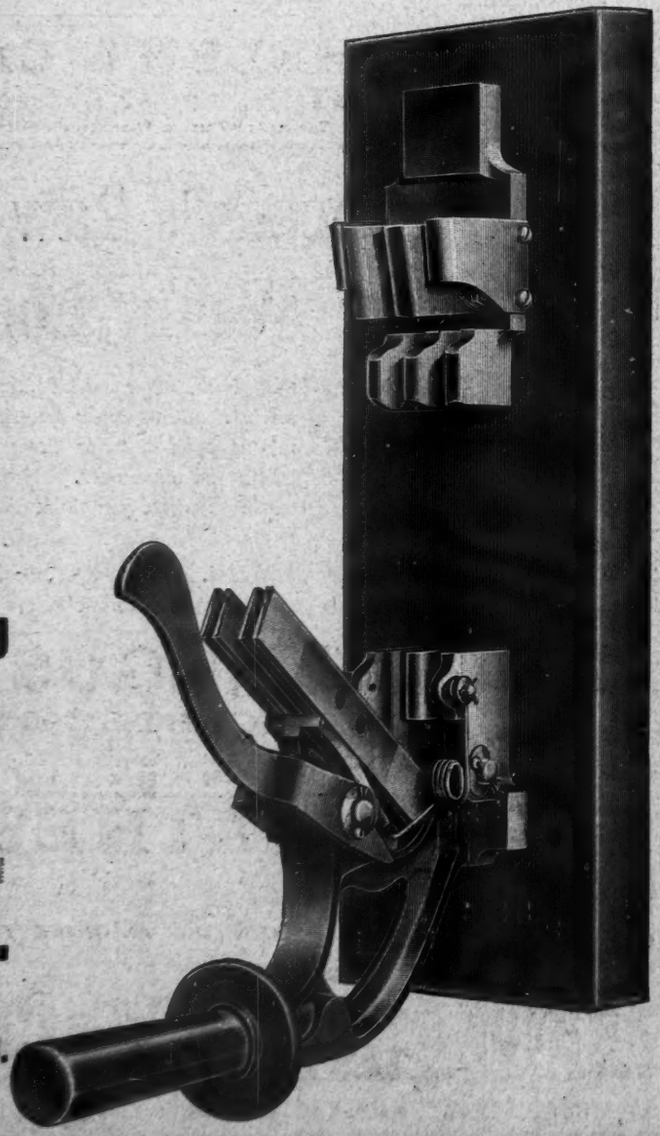

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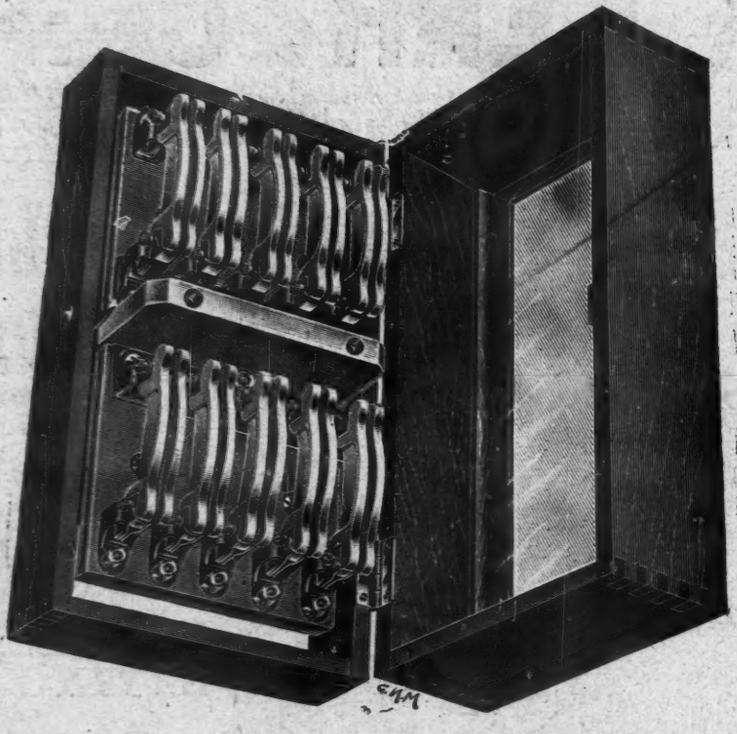

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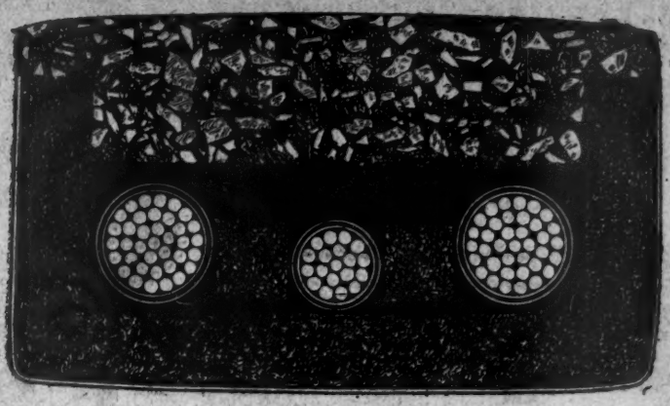

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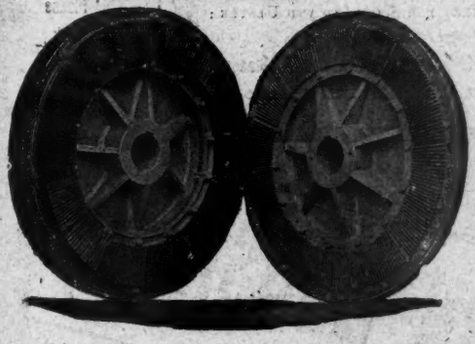

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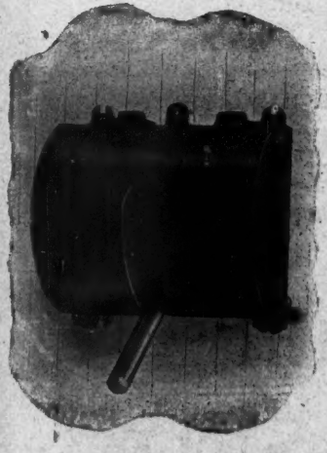

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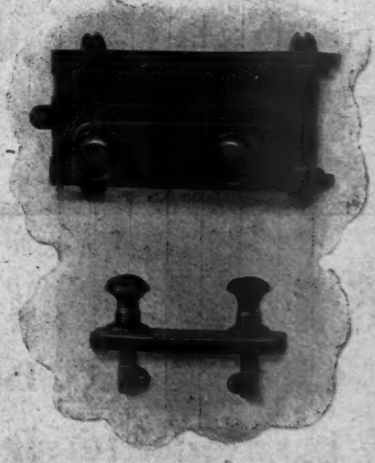

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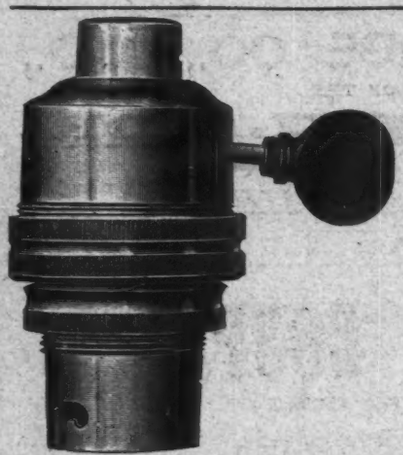

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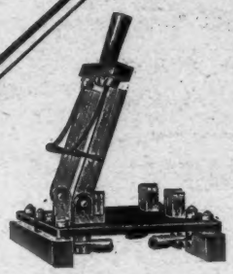

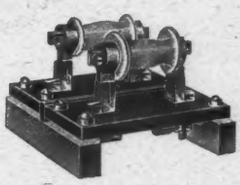

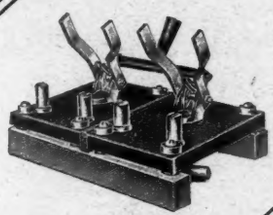

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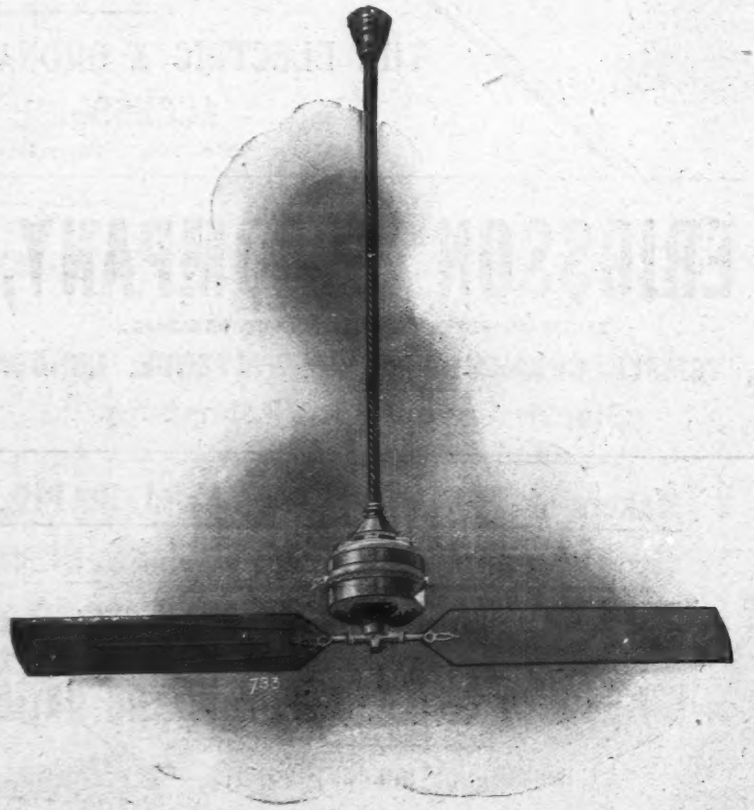

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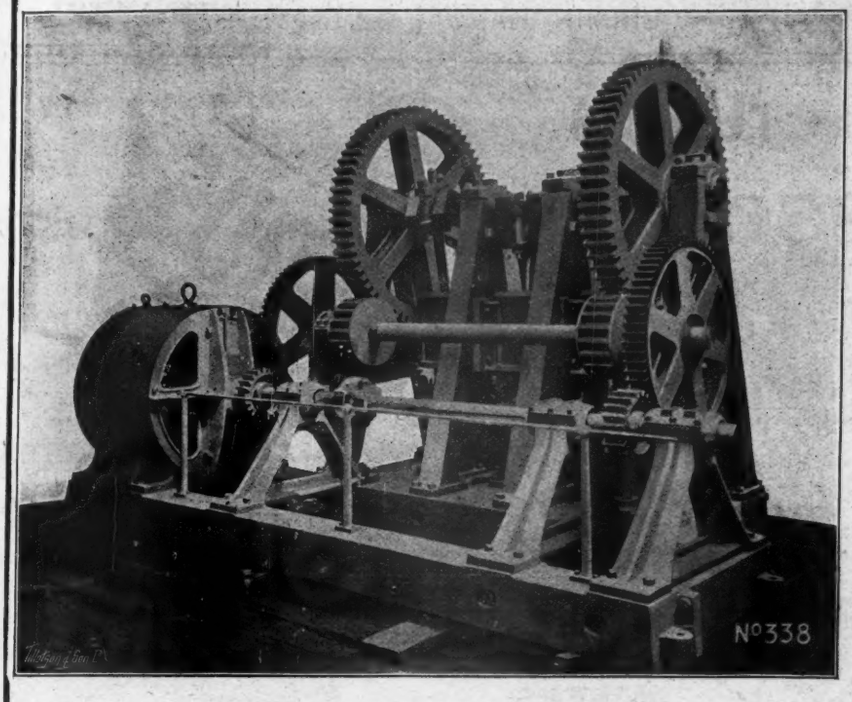

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Driven by one of our 125 B.H.P. Enclosed Motors. No. 12 Size.

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Open and Enclosed

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FOR

SHIPYARDS,
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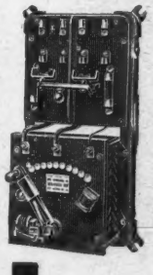

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We do more for you than simply sell you a Starter or Controller, we give our careful attention to your special needs, and you have the benefit of our years of Experience in

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BALANCE WEIGHT SETS
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LOOP IN CEILING ROSES
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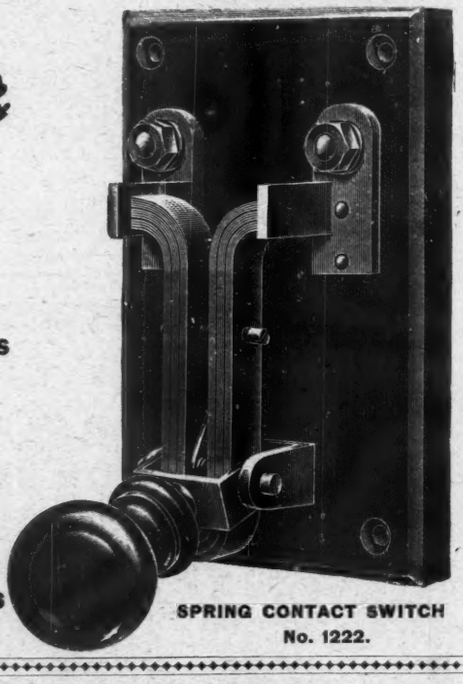
LAMPHOLDERS
WALL SOCKETS
FLOOR SOCKETS
ACCUMULATOR SWITCHBOARDS



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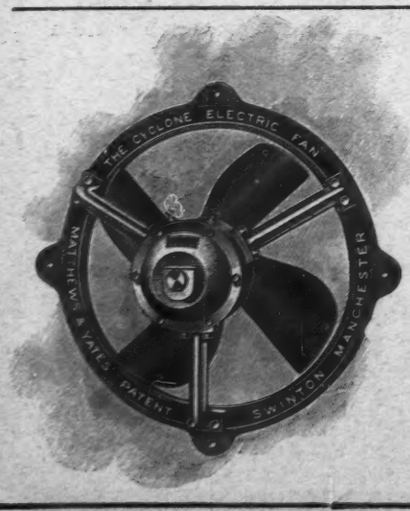

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Are Guaranteed to Work

EFFICIENTLY, ECONOMICALLY

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Thousands of Cells in Successful Use.

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Brighton Corporation
Bristol Corporation ... ... 2 Batteries
British Electric Plant Co. (Alloa)
Broughty Ferry Dist. Council
Bruntwood, Cheadle
Bury Corporation
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Cleckheaton Dist. Council
Cliveden
Crystal Palace Supply Co. ... 5 Batteries
Dublin Corporation
Dundee Corporation
Edinburgh Royal Asylum
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Great Yarmouth Corporation
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Liverpool Corporation ... ... 12 Batteries
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London County Council (Victoria Embankment)
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Midland Light and Power Co. (Leamington)
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Norwich Electricity Co. ... ... 2 Batteries
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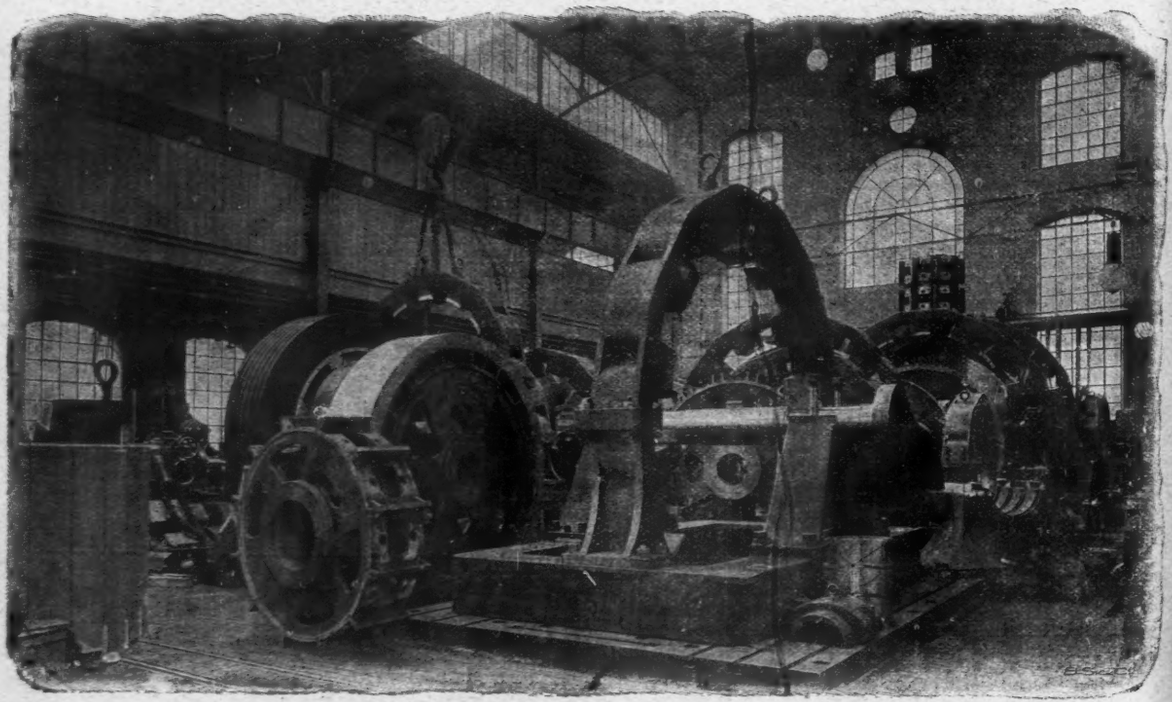

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Our "SENTINEL" High-Speed ENGINES

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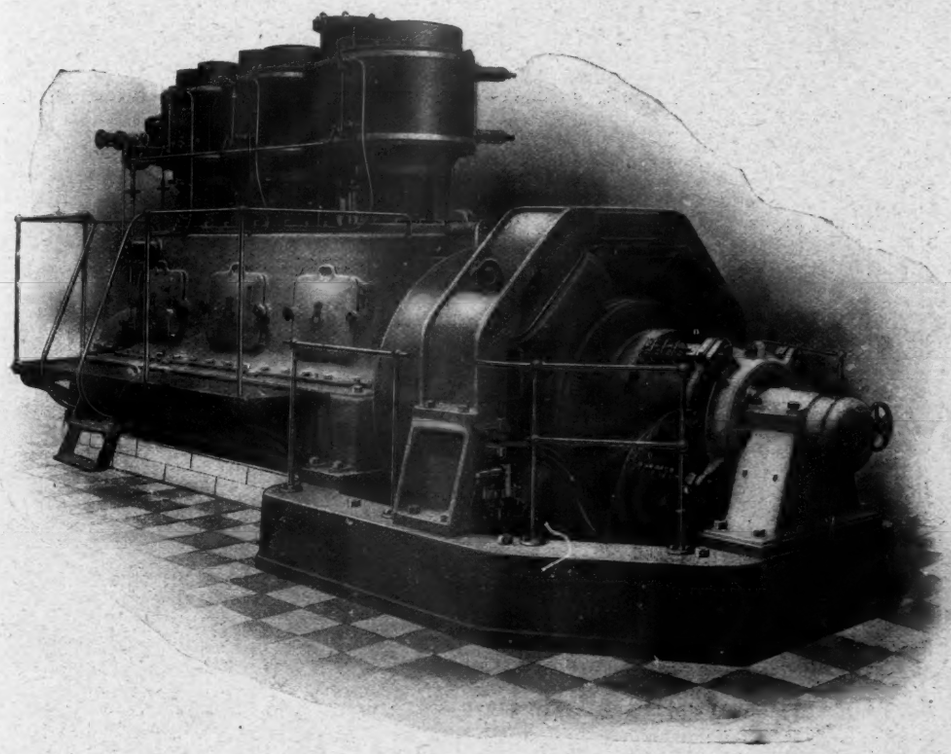

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400 I.H.P. "Sentinel" High-Speed Engine.

Three-crank Triple-expansion Double-acting Forced-lubrication Type.

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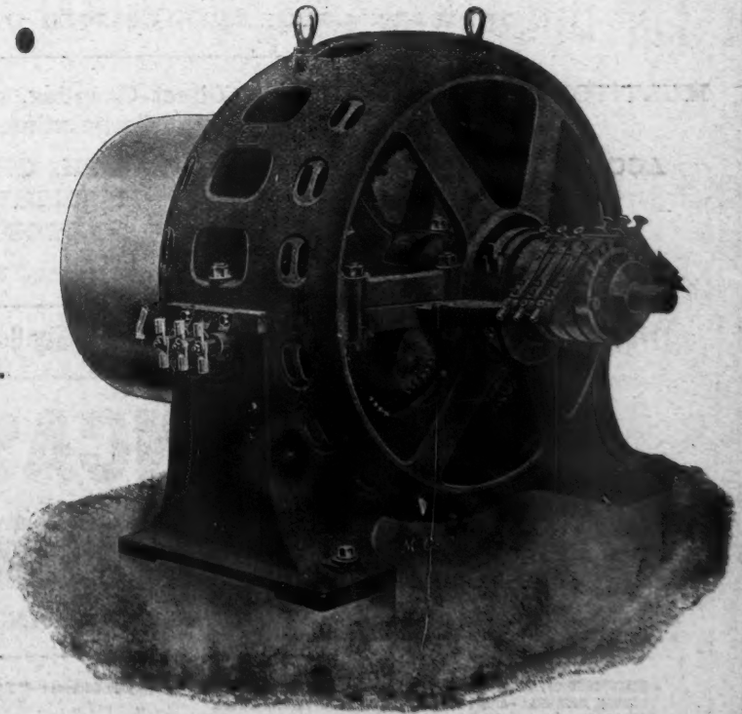
STANDARD FREQUENCIES, 25—42—50.



HIGH EFFICIENCY. POWER FACTOR.

Lists on Application.

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Dust-Proof or Ventilated, All Sizes.

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For Belt Driving or Direct Coupling.

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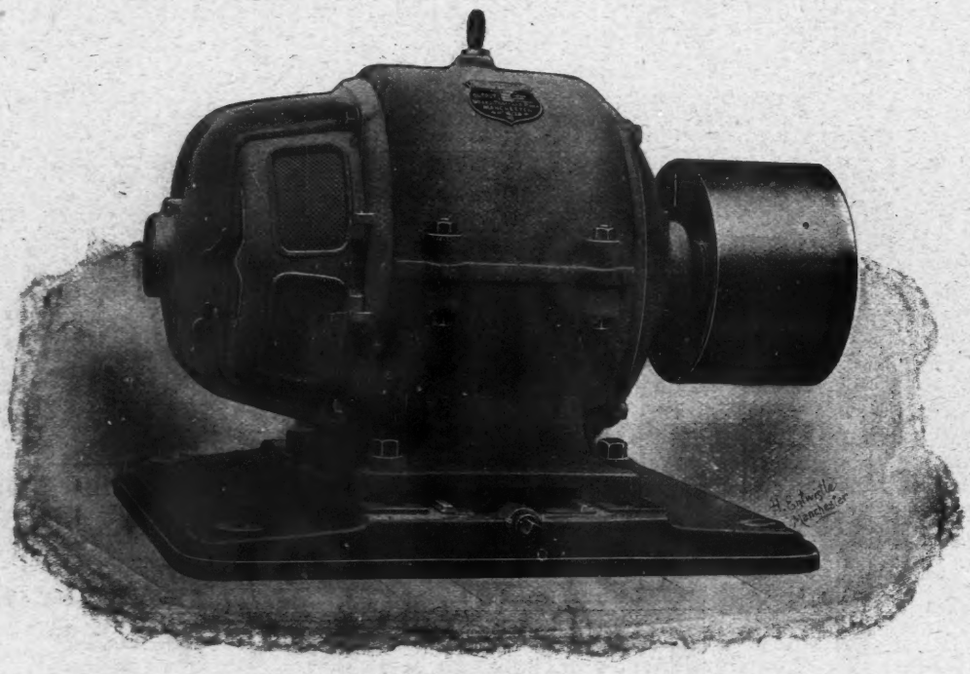

STANDARD 4-POLE SEMI-ENCLOSED C C TYPE MOTOR.

MULTIPOLAR GENERATORS for Direct Coupling, as supplied to, or on order for the following Corporations:—

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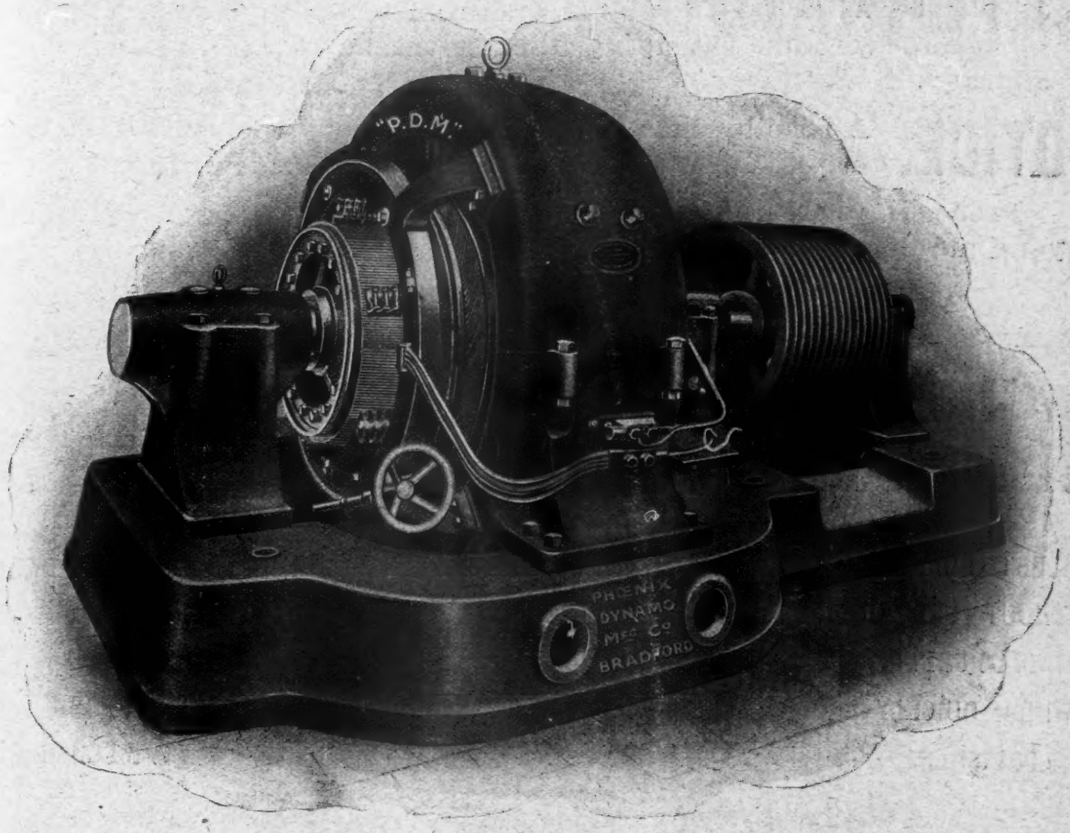

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DIRECT & POLYPHASE GENERATORS to 500 kw.
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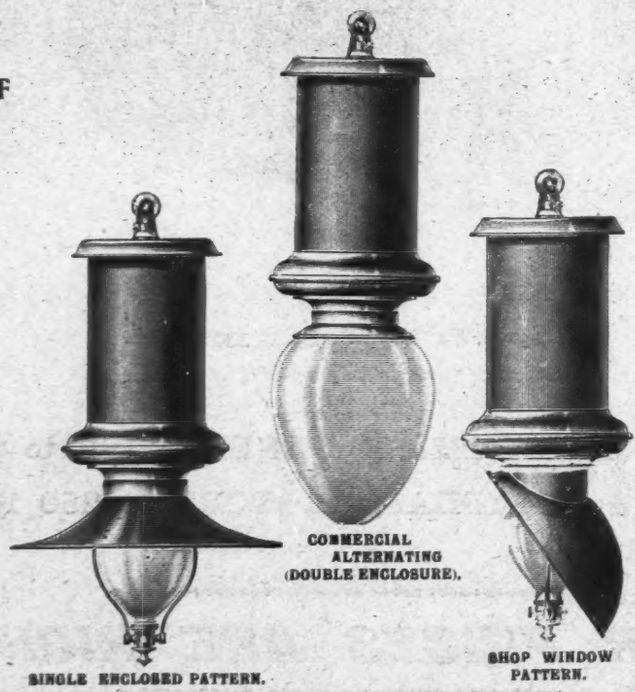

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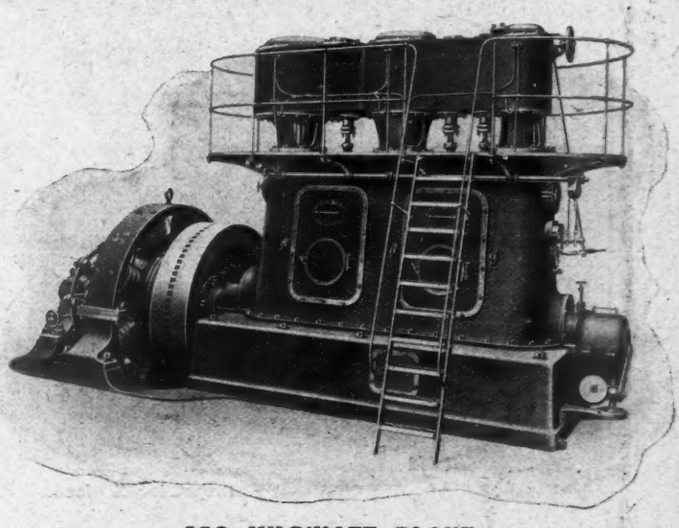

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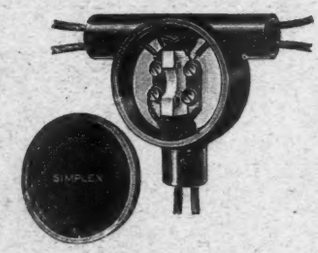
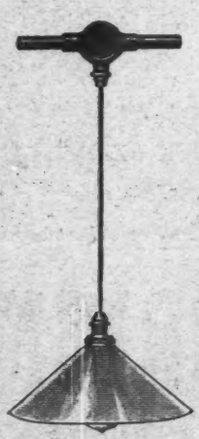


"T" Connection Box.

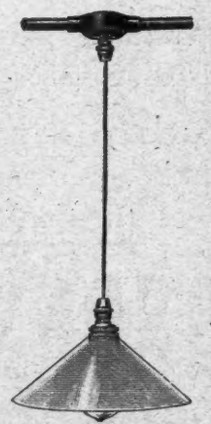
Horizontal Pendant Fitting.

Inspection X Piece.

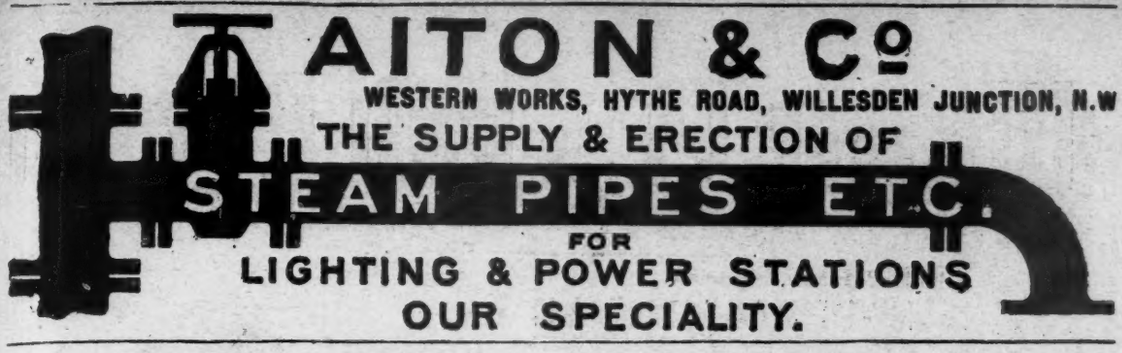


Vertical Pendant.

Switch showing New Mounting



Horizontal Pendant.



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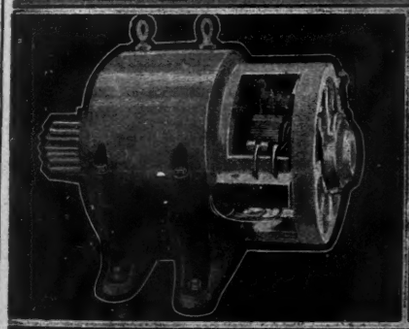

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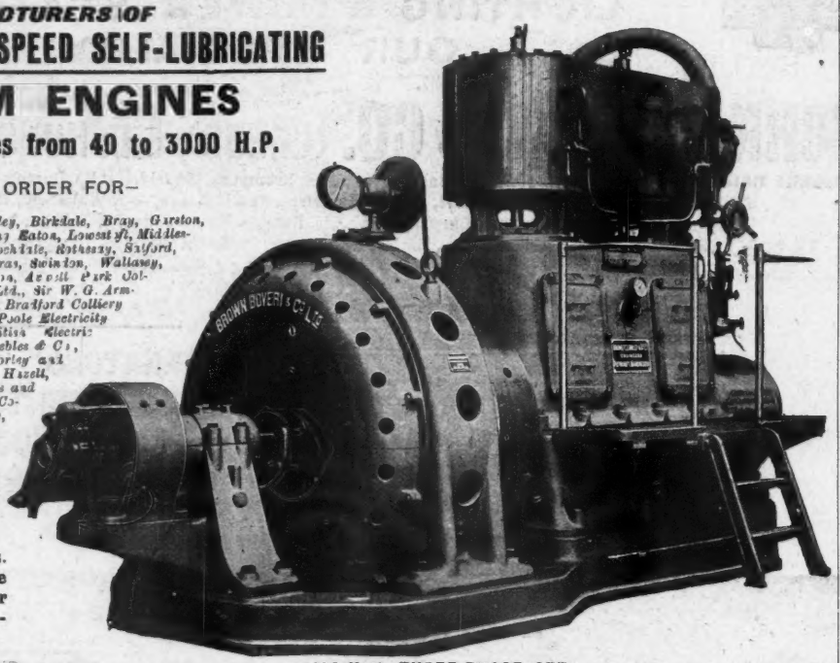

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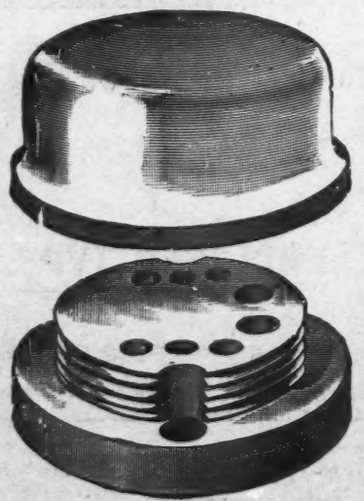

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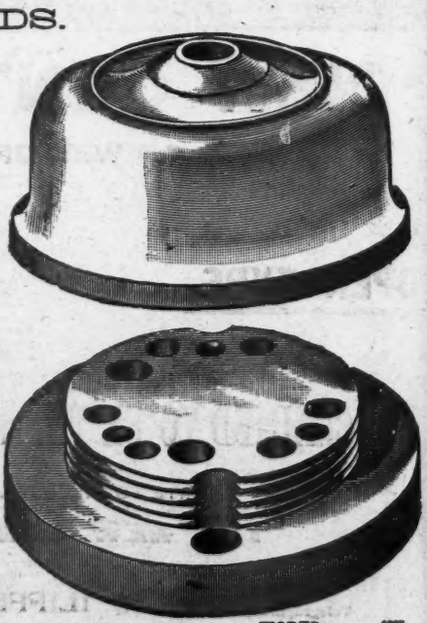

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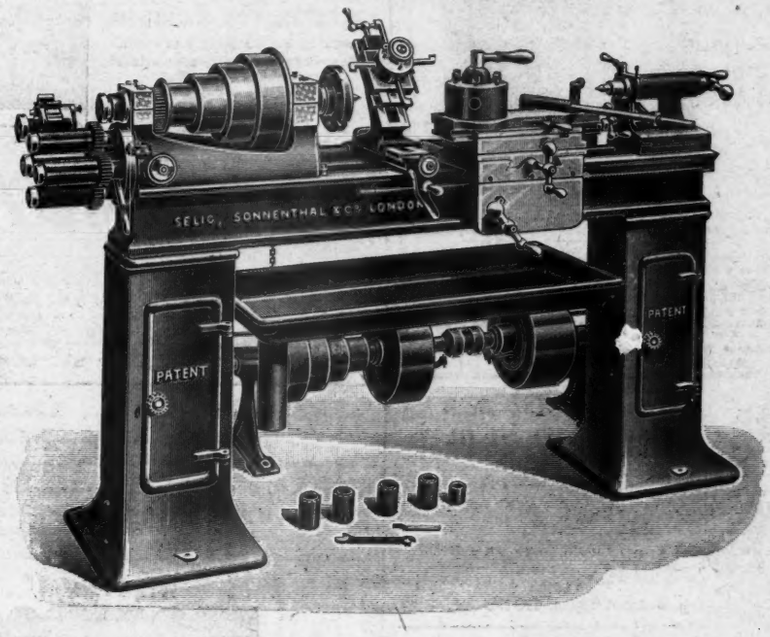
The turrets carrying *four* copy screws and followers of different pitches of thread, *this number of threads is always available for instant use.*

The chasing slide is also fitted with a turret carrying four chasing tools of similar pitches of thread to the copy screws.

Right and left-hand threads can be cut with the same copy screws and followers.



ADVANTAGES.

Immense saving of time, and, consequently, increased output.

Either one of the four copy screws and its corresponding follower *can be brought into use instantly.*

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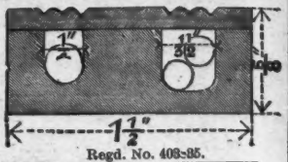

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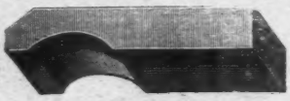

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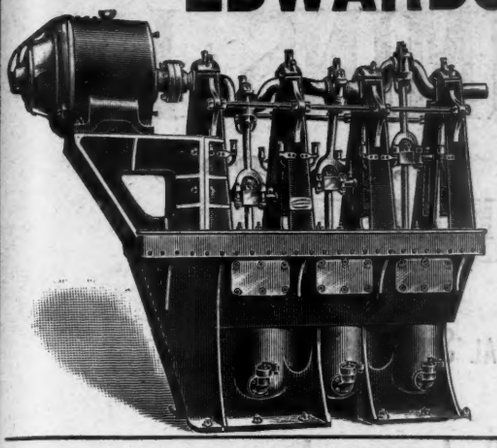

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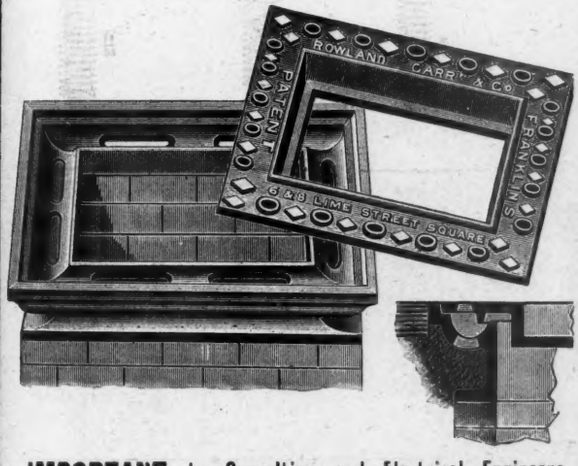

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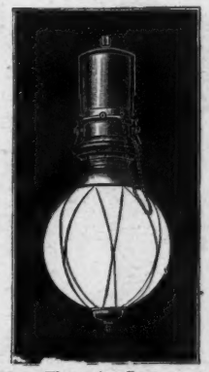

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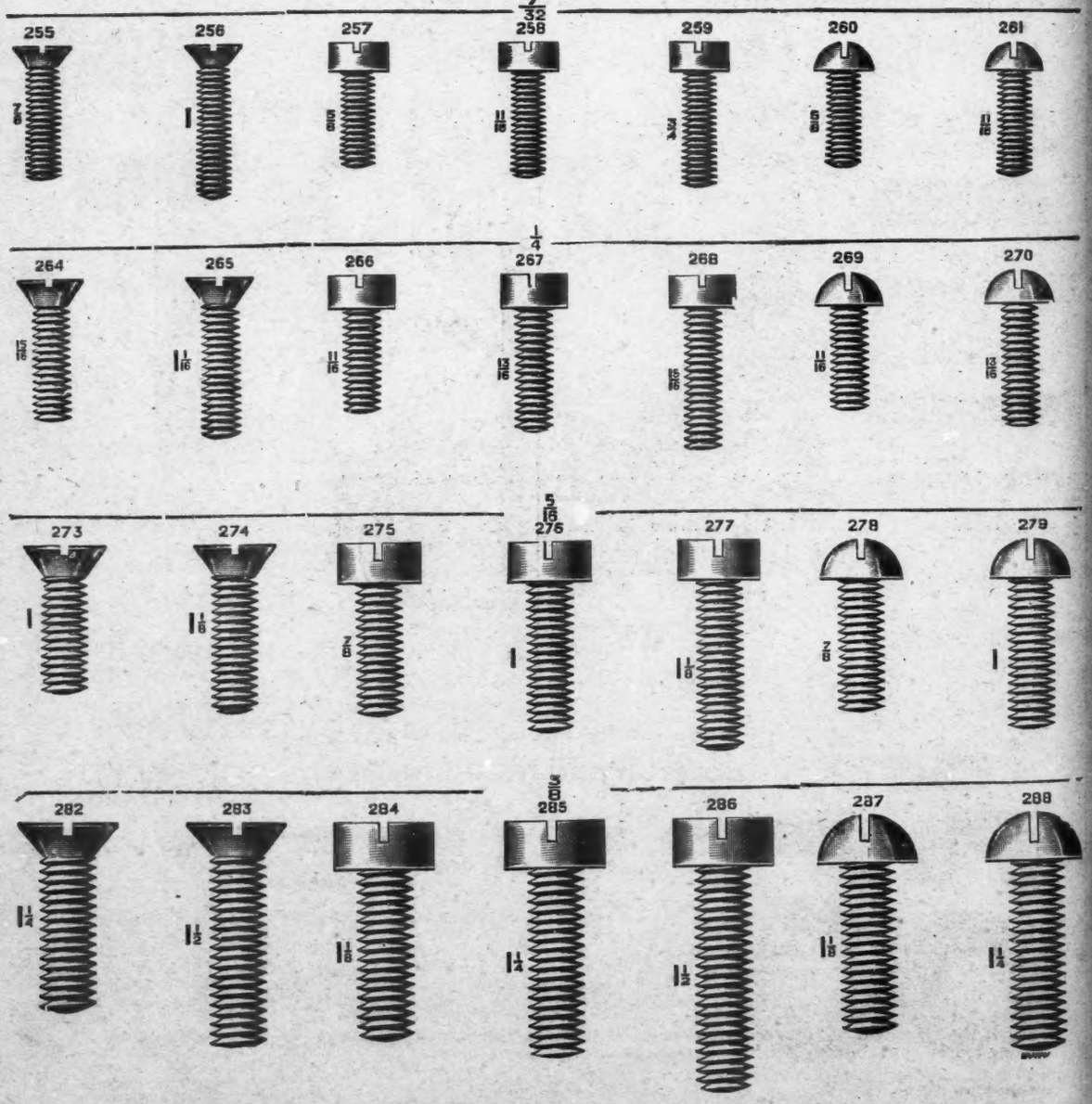

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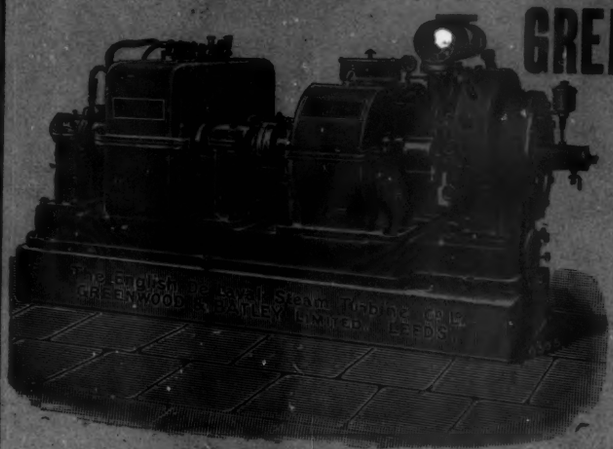

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